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OF THE

ROYAL SOCIETY

OF

QUEENSLAND

FOR 1944

VOL. LVI.

ISSUED 12th SEPTEMBER, 1945.

PRICE: FIFTEEN SHILLINGS.

Printed for the Society
by
A. H. TUCKER, Government Printer, Brisbane.

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VOL. LVI., No. 1.

Proceedings of the Royal Society of Queensland.

Presidential Address:

A RETROSPECT OF MODERN PSYCHIATRY.

By John Bostock, M.B., B.S., D.P.M., Department of Medical Psychology, University of Queensland.

(*Delivered before the Royal Society of Queensland, 27th March,* 1944.)

Before proceeding with the Presidential address of the Royal Society of Queensland, which I am privileged to give, I wish to place on record two outstanding events which have occurred during the past twelve months.

The government, through our Premier, the Hon. F. A. Cooper, has made a substantial grant to the library of the Royal Society, in order to assist in the preservation of our records which are regarded as being of vital importance to the scientific world of Queensland. With regard to the war, it will interest all members to know that your president and the council pledged themselves to assist not merely in the war effort but also in any scheme for the improvement of library facilities in our state.

The year has seen the passing of the first secretary of the Society, Mr. Henry Tryon. It is regretted that he did not live to present an account of those early days. He had promised to do this. No reference to Mr. Tryon would be adequate without mention of the sterling qualities he possessed. Among them were his perseverance in the face of obstacles, his courage and the wide variety of his scientific interests.

THE ADDRESS.

In choosing as my theme for this evening "A Retrospect of Modern Psychiatry," it has been my desire to introduce one which illustrates that wide scope of enquiry which not merely underlies the scientific ideal but is the guiding principle of the Royal Society itself. Whilst no one can deny the advantages of specialism, there is no doubt of the danger that it may be purchased at the price of isolationism. All too frequently we are dragooned by the urgent necessities of our calling and the limitations of the time factor into an intellectual privacy which has harmful results. The meetings of our Society are a valuable means of combatting this tendency.

It will be my endeavour to show in this study that psychiatry illustrates the wide variety of scientific contacts which are necessary if progress is to ensue. Attention will be drawn to certain principles of research. To-day we are apt to think of streamlined systems which flow inexorably if not effortlessly to a desired conclusion. This does not apply to research which is often hampered by over-planning.

Progress is discontinuous and at times erratic. Discoveries are kept for decades in the cold store of forgotten memories. Research in one field produces results in unexpected places. Above all we are reminded that all knowledge is interrelated. The observation of a fruit may give clues as to the working of a planet, the study of a flea may permit the saving of a million human lives. Such facts are reminders of the need for intellectual freedom without which progress cannot escape the strangle-hold of outworn tradition.

PSYCHIATRY DEFINED.

I propose in this address to give a brief retrospect of modern psychiatry, touching on changes which have occurred during my own lifetime and largely during the period I have been a practising psychiatrist. It will be seen in the course of this retrospect that the psychiatrist has borrowed profitably from the bank of science. Psychiatry is a field of medicine whose boundaries are extensive but vague and ill-defined, for at the one extreme we see conditions which are entirely functional, being unassociated with demonstrable physical change, and at the other there are grossly organic diseases. The psychiatrist is concerned with the disorders of a psycho-somatic (or mind-body) nature, not with diseases affecting tissues or organs, or systems of organs. In fact he is dealing with the total reaction of patients as social or biological units. The total reactions of individuals are designated as behaviour. The purpose then of psychiatry is to study and treat conditions characterised by disordered behaviour.

Biologically considered, behaviour is the product of the reciprocal reactions between the organism and its environment. As pointed out by Dr. S. E. Jones the reactions have a double polarity, for the individual modifies and acts upon his environment and the environment acts upon the individual. This double aspect is important in psychiatry because behaviour disorders are largely determined by the influencing of environment on the individual. Thus it will be seen that psychiatry is concerned with highly complex relationships over a very wide field from that of the welfare of the individual to that of the entire community.

GENERAL PARALYSIS OF THE INSANE.

It is fitting to commence this retrospect by a consideration of General Paralysis of the Insane for it was the first psychiatric entity to be identified. The clinical and pathological changes were completely defined in 1826.

When I first took up a position in a large mental hospital, it was a common sight to see rows of beds in which general paralytics were lying, paralysed in body, bankrupt in mind, surviving in mere vegetable fashion and awaiting the inevitable termination in death which came within a year of hospitalisation.

To-day the young psychiatrist rarely sees such a case. The course of this disease has been entirely changed. The steps toward this truly dramatic alteration in outlook are intriguing.

It was not until late in the 19th century that syphilis was generally accepted as the cause of this disease. Previously many authorities regarded it as due to the "stress of modern life" owing to the fact that it was most common in members of the learned professions and Army officers.

We read that in 1893 Kirchoff considered "the development of the disease is favoured by the noxious influences inherent in the agitated life of recent times."

The view that syphilis was responsible was strengthened by the application of the Bordet-Gengou or Wasserman Reaction and was ultimately confirmed when in 1913 Naguchi and Moore demonstrated the presence of spirochaetes in the brains of general paralytics.

It will be seen that a period of 90 years elapsed between the recognition of the disease entity and the elucidation of its aetiology.

Although the proven remedies for syphilis were employed with many variations, including the arsenicals "606" and later derivatives of the Erhlich and Hata discoveries, the curative results were entirely fruitless. A diagnosis of General Paralysis still remained the equivalent of a death sentence.

The first rays indicating the dawn of therapeutic success were ushered in in 1917 when publicity was given to the success of Wagner von Jauregg in treating this disease by inoculating his patients with malaria. Many years earlier he had suggested the use of fever for the treatment of this disease. This suggestion was based on the quite common observation that a patient suffering from mental disorders frequently had a remission of symptoms in the course of or following an intercurrent febrile disorder.

VICTORY THROUGH HEAT.

At first we thought that the malarial infection had a specific antagonism to the spirochaete of syphilis. Later it was shown that equally beneficial results were obtained by other methods for inducing high temperatures. A wide variety was used including relapsing fever, typhoid inoculations and bacterial products. Later (in 1930) pyrexia was induced by diathermy and air-conditioned chambers. Finally the property of the electric short wave (25 metres) was used.

It now seems obvious that the curative agency is heat, in that a temperature of 106° F. is fatal to the spirochaete.

It is interesting to reflect that Louis Pasteur discovered the delicate relationship between organisms and the temperature of the medium in which they live during experiments with Anthrax. He noticed that the bacillus can be grown in cultures only with great difficulty at temperatures of 43° C. or 44° C. It occurred to him that this might be the explanation for the known immunity of fowls from anthrax. The normal temperature of fowls is 42° C. On March 19th, 1878, Pasteur demonstrated two fowls which had been plunged into the same bath at 25° C. One was inoculated with 5 drops of an anthrax culture. It contracted the disease and died whereas its control companion suffered nc disability.

Here we see a hint on a direct approach on the therapeutics of infection yet it was only applied many years after publication.

This story of victory over disease by heat illustrates the inter-relationship of the science in which the biologist and the chemist have played a prominent part. We might emphasize the place of the physicist. The story of the evolution of wireless is familiar to most. Even the comparatively young will remember Marconi's conquest of the Atlantic and the arrest of Crippen as a dramatic result of this new method of

communication. I must confess an inability at that time to conceive that a radio transmitter would a few years later be curing Dementia Paralytics.

Electro-magnetic induction was tried by Neymann, Osborne and Holmquest in 1928. Those who have seen this type of treatment will confess that it savours of the miraculous. The heating element is a loop or coil resting on the blankets. The following is the description of a technique used by Guy P. U. Prior, and recorded in the Year Book of Neurology, 1937:—

"The patient is insulated against loss of heat by use of terry cloth, a rubber sheet and six blankets which are wrapped around him and around which 3 turns of the cable are laid. The patient is given a hot bath, an enema, 10 ozs. of hot milk or coffee and 6 grains of Sodium Heberal two hours before treatment. Pulse, respiration and temperature are recorded every 15 minutes and a hot drink consisting of glucose 10 per cent in Saline solution 0·6 per cent. is given freely. The temperature must be kept about 103·4° F. for 8 hours and during 2 of these hours it is between 105·2° and 106° F."

As a result of such modern methods, the patient suffering from General Paralysis has now a positive prospect of arrest of the disease. This improves in ratio to the time from onset of symptoms. The early treatment produces the best results. Such considerations have a significance to-day.

COMING SHADOWS.

We are used to those financial taxes which are an inevitable concomitant to the war effort. We may fail to remember those invisible taxes which burden the national health. War produces a bounteous crop of syphilitics from which will follow a future harvest of general paralytics.

In 5, 10, 15, or 20 years, we may expect to see cases which illustrate the classic train of symptoms. Let us hope that our prophylaxis will be as perfect as possible, that our heat therapy so ably commenced will improve through the years. We may find that every syphilitic should receive heat therapy in order to sterilise that nidus of brain infection which, lying dormant for a decade, can awake, we know not why, to virulent activity and produce those deadly results to which I have referred.

It is not surprising that efforts have been made to utilize the converse effects of cold therapy. Patients have been placed under conditions of extreme cold for long periods. Whilst good results have been claimed, the dangers of pneumonia and other complications have militated against success.

SHOCK TREATMENT.

Twenty years ago in the wards of every psychiatric hospital, in the outpatients of every psychiatric clinic and indeed in every doctor's consulting room were cases in which the treatment was of the "By God and by Guess variety," a compound of hope, time, aperients, fresh air and drugs. One would see—

The melancholic, who for months or years, would remain emotionally depressed, indifferent to life, often indeed actively searching for death

or A young man in the prime of life, weighed down by such a load of anxiety, that a decision became impossible and even interesting work could not be undertaken through his inhibitions and disinterest

or A woman whose chief thought was the means of killing her children lest they too would suffer

or A man the victim of a ceaseless obsession that he must perform an act of antisocial nature, which must inevitably produce his ruin.

We have seen such cases in hundreds, nay thousands. Whilst cure often ensued, its course was slow and unpredictable. Often the coroner's court and the mental hospital were the final repository. We have prayed earnestly for a magic philtre which would disperse the evil cloud of depressive thought and make the obsession recede beyond the ken of consciousness.

To-day our prayers have been answered through the modern miracle of shock therapy. The word "Miracle" is not an indication of enthusiasm run riot but of sober fact tempered by experience. With shock therapy each patient I have mentioned has the probability of freedom from symptoms within two or three weeks. Within a week the suicidally inclined. the child-murderer, the anxiety-ridden and the obsessed may be taking a cheerful intelligent interest in their surroundings and be so divorced from their depressive past as to forget entirely their morbid thoughts.

Within the last ten years, the advent of shock therapy has completely revolutionised the practice of psychiatry by eliminating the time-lag of the old proceedings and creating an early atmosphere of enthusiastic co-operation.

The story behind shock is another admirable illustration of scientific progress, its interrelationship with other branches, of unexpectedness and lack of continuity.

In the year 1781 a William Oliver of London described that a case of mania improved after a course of camphor had given convulsions. 150 years were to elapse before the technique became common practice and then it was introduced almost simultaneously by two independent workers on different lines.

In 1928 Manfred Sakel was using Insulin in the cure of drug-addiction and found that sometimes when large amounts are employed severe hypoglycaemic shocks and convulsions produce remarkably successful therapeutic results.

Prior to 1932, it had been noted that if convulsions occurred in a case of Catatonic Schizophrenia, there might be a remission, and that remarkably few epileptics suffer from this common mental disorder.

In 1933, von Meduna, after experimenting with animals, injected an intra-muscular camphor preparation (25 per cent. of oleum camphoratum) into a series of human patients. The method was clumsy since the convulsions were uncertain. Soon it was replaced by intravenous cardiazol—pentamethylene tetrazol—in 10 per cent. solution.

A list of favourable results was published. The treatment soon swept the world and was tried in many thousands of cases. Gradually the relative scope of usefulness for Insulin and Cardiazol was mapped out. It was discovered that although the latter was designed for

Schizophrenia, the best results were obtained in other conditions. In spite of inherent risks of fracture or dislocation, cardiazol achieved the wider usage on account of ease of administration and safety to life.

In cardiazol therapy the convulsion occurs within 20 seconds. The patients wake up in a few minutes and can get up. They need not be confined to bed. In insulin therapy very large doses are required and highly skilled medical and nursing attention is needed for five or six hours. As coma is induced little imagination is required to realise the risks involved and the necessity for a standardised technique.

Although the psychiatrist was gratified with the new therapeutic methods, he began to pray for a modification. Cardiazol creates fear of the treatment in the minds of the patients. We also wanted a greater immunity from fractures and dislocations. Again the physicist rose to the occasion. Cerletti and Bini, in 1937, experimented with the use of alternating current through the brain for the production of convulsions. They found that this was an effective agent and had certain advantages over the pharmacological method. In brief, the alternating current is passed trans-temporally at a voltage ranging from 90 to 200 for a period of time from ·1 to ·5 seconds. Immediately the current is passed the patient becomes unconscious and herein lies the great advantage over the injection method. The effect being instantaneous, the patient experiences no discomfort. If the preselected voltage and time are adequate, a convulsion commences within a few seconds and lasts for ¾ of a minute.

THE ELECTRO-ENCEPHALOGRAPH.

Twenty years ago the psychiatrists envied the cardiologist for the possession of the electro-cardiograph which, by registering differences in electrical potential, gave an accurate measurement of heart-action. We prayed for some such instrument in order to wrest the hidden secrets of brain-function. Our only recourse was through brain-sections under the microscope, the X-ray which merely revealed shadows and the newly developed technique of encephalography wherein the injection of air into brain and spinal cavities increased the scope of such shadow-pictures. These measures, whilst helping in the elucidation of brain-substance, could not give a hint of the underlying dynamics.

A commencement to new knowledge was made in the early thirties of this century by recording electric variations in skin reactions whilst the patient was influenced by stimulating ideas. It was found that there is a relation between emotion, anxiety, and skin resistance. The much publicised "Lie detector" is a variant of this type.

In 1934, Hans Berger revolutionised the field by his use of an oscillograph which minimised the effects of skin resistance. He was able to show the presence of two types of electrical oscillations. The most obvious of these is the "delta" which consists of rhythmic changes in electric potential from 0 to 100 microvolts at a frequency of 10 per second. In most people the waves are only present when the eyes are closed and the mind at ease. The "beta" waves are smaller and of a frequency of 18 to 25 per second. They are associated with the Frontal lobes.

The use of the Electro-Encephalograph has already borne fruit. It is being widely used in the localisation of cerebral tumours and as early

as 1936, Grey Walter was able to report four cases in which slow waves pointed to the site of a growth which was verified at operation or post mortem.

Light has been shed on the age-old, mysterious yet very common condition of Epilepsy. It has been shown that the fit or seizure is but the outward manifestation of disorder in brain-rhythm potentials. Major and minor attacks show an increased voltage during its height. It is possible to differentiate by the wave-speed, those vague muscle jerkings, bouts of irritability and other minor variants which are a part of the Epileptic Syndrome. As a result of these discoveries, epilepsy is now described as a "Paroxysmal Cerebral Dysrhythmia."

The encephalograph is to-day being used not merely as a help in diagnosis and treatment but has been employed medico-legally to discover epilepsy in the criminal. During a recent case choice of the alternatives "prison or hospital" actually depended on the encephalographic findings.

Quite apart from the above one must refer in this retrospect to the extraordinary change in outlook for the epileptic during the last 25 years. Only those who remember the "era of the Bromide" will appreciate the dull intellects, the spotted faces and demented appearance of the old-time sufferer. To-day through the introduction of the Barbiturates and Dilantin we have at our disposal drugs which will in most cases control the fit without producing an excessive drowsiness.

DISCOVERY OF NEW ENTITIES.

Time passes. I must all too briefly refer to the well-known scientific process of collecting facts, analysing the material and splitting off entities into a new classification. Thirty years ago any of the following patients would have been wrongly classified and treated:

1. A man has had only two fits in his lifetime *both* when surfing.
2. (*a*) A fireman complains of faintness *only* when stoking his engine. He is nervous.
   (*b*) A woman having *once* been giddy in the street develops fear of going out of doors.
3. A man falls to the ground when *excited* and falls asleep on the least provocation even when driving a car.
4. A young adult, after a severe attack of "fever," sleeps by day, is awake at night and becomes clumsy in his movements and sees "double."

Case 1.—The cause and treatment of Diabetes is now a commonplace of knowledge. The use of Insulin in decreasing excess of blood-sugar is universal. That psychiatric states can result from a decrease in blood-sugar is a new discovery. The man mentioned above who, after heavy exercise when fasting, had fits was found to have a low blood-sugar. He is not an epileptic but a hypoglycaemic who by regulating his food-intake can command his destiny. We now know that hypoglycaemia can produce a wide variety of symptoms including mental confusion, langour and pains.

Case 2 (*a and b*).—Both have previously been treated as merely nervous invalids. Actually they belong to the "water-balance syndrome." Our stoker loses much sweat in the hot task of feeding his engine in a tropical condition. He has merely a salt-deficiency. The

lady suffers from water-pressure change in her semicircular canal. If she *excludes* salt from the diet and uses a substitute for the Sodium radicle, the giddiness will disappear. The fireman must take *more* salt.

Case 3.—Twenty years ago a sleepy man who, because of nervousness, could not smash with a racket or hook a fish was just another example of "nerves." Now we see the characteristic story of "Idiopathic Narcolepsy" for which there is a specific remedy in Ephedrine or Benzedrine.

Case 4.—To-day the combination of fever and drowsiness followed by character changes is so clear that even the tyro can make a diagnosis of sleeping sickness or Encephalitis Lethargica due to an infection of the brain. Such cases and their variants are quite common. It is interesting to note that the first recognition occurred by Constantin von Economo in 1917 and was later identified with a "mysterious disease," occurring in Australia in the same year.

As Professor Economo says:—

"Every psychiatrist who wishes to probe into the phenomena of disturbed mobility and changes of character, the psychological mechanism of mental inaccessability, of the neuroses, etc., must be thoroughly acquainted with the experience gathered from Encephalitis Lethargica.

Every psychologist who in future attempts to deal with psychological phenomena . . . . and is not well acquainted with encephalitic patients . . . . will build on sand."

Had I the time, I would have liked to describe other entities, such as the rôle of vegetable or animal extracts (or chemical substitutes) and vitamins in assisting the psychiatric patient. It is not merely in those serious cases such as Pernicious Anaemia or Myasthenia Gravis that the new knowledge has been important. To-day the woman in every home who is going through the menopause can do so with an ease unknown to her mother. We are beginning to use the endocrine glands with good and indeed often brilliant results.

Concerning Vitamins, the discovery of the B1 and B2 complex has opened new avenues of treatment. With their aid we can achieve the hitherto impossible. It is spectacular to see a crippled neuritic almost take up his bed and walk. It is satisfying to be able to help the array of the debilitated through the avitamosis of a faulty diet, take on a new life of increased happiness and efficiency.

Were the time available it would be profitable to discuss the problem of allergy, which relates to our sensitivities toward a wide series of substances, both in the body and without. We are realizing such mechanisms may give headaches and other symptoms. Often the patient manufactures his own poisons.

THE SOCIAL SPHERE.

The above references will I trust serve to emphasise the wide scope of psychiatry and its linkage with diverse studies. I shall conclude by drawing your attention to the extraordinary change which has occurred in our appreciation of the psychology of man the individual and of man in the mass. There has been a profound revolution in our viewpoint, so that we are beginning to see the world as it is—a correlated living

whole and not as a mere aggregation of separate individuals living separate lives. Such change did not occur overnight nor is it complete. Whilst it is true to say that psychiatry has outgrown its swaddling-clothes and can use its eyes with advantage, it cannot see all, but the same might be said of all departments of knowledge for there is always further knowledge over the horizon.

During the latter part of the 19th century, psychiatry was largely based on materialism. This attitude persisted into the present century as may be seen from the attention given in the journals to brain structure and clinical tests. It is true that Braid and Bertrand produced mesmerism by suggestion and coined the term hypnotism but this psychological attitude was unusual. It received an impetus through the impressive work of Charcot in the seventies and eighties on hysteria and hypnotism.

Following this one must chronicle the activities of a group of men who hammered the psychological viewpoint to a point when it dominated the entire psychiatric picture. We must include Babinski, Dubois and Dejerine, Coue, Janet, Adler, Jung, Morton Prince, Watson, McDougall, Rivers and Freud.

It must be conceded that spectators on the arena of the psychiatric battleground have had a remarkable experience. As each teacher advanced his views he collected followers who formed a "school of thought." Whilst at the time, this differentiation seemed reasonable, to-day the lines of demarcation seem tenuous and flimsy. Through death the colourful and forceful leaders have departed, leaving us free to abstract from each according to our needs and to collate without prejudice or bias. Only the mentally blind will deny us the existence of a glorious heritage.

As this is a short personal retrospect, one cannot be expected to give honour to all. One must mention Freud for his dynamic concept of the striving soul, impelled by the race-need for reproduction, Rivers for his insistence on the importance of current happenings to the psyche, MacDougall for stressing the variety of emotional and instinctive forces which pattern our lives, Adler for teaching the rôle of inferiority striving for recognition, Dubois for his realisation of the power of persuasion, Watson for showing the importance of the study of animal behaviour, Kraepelin and Janet for indicating the need for careful case-taking in medical records, Binet and Simon for demonstrating that any careful analysis may have far-reaching results, Jung for his analysis of psychological types.

It must not be thought that the ranks of the materialists were silent during the period under review. Kretschmer stressed the importance of body-type on character and temperament. The endocrinologists draw our attention to internal secretions which dominate personality. Cotton and Robertson will not let us forget the devastating rôle of constipation and focal sepsis. Our dietitians thundered the need for a balanced intake of food. To-day, thanks to this spate of ideas, we are able to survey the whole field of human endeavour and envisage each problem in an appropriate setting. Our knowledge of the bipolarity of our lives, the interrelation of cause and effect, between self and environment, between "I, you and they, our betwixt and betweens and surroundings" has created the new psychiatry

which is concerned equally with social customs as with individual usage. Thus the prevention and cure of a disease may be visualised as the need for alteration in the social way of life and not merely an occasion for individual chastisement or re-education. When the psychiatrist is asked the secret of a nervous and mental disorder he can discuss beyond the immediate remedy to plans for future needs . . . more educated parents, early training on right lines for children, better homes, better modes of living and surer routes to the goal of individual and race happiness.

If it is ever justifiable to deduce future events from past performance, one must regard the future of psychiatry with an interest which should not be enclosed within the narrow confines of a single specialty.

As Sir James Mackintosh pointed out more than a century ago:—

"Diffused knowledge immortalizes itself."

And so in conclusion we return to that movement for freedom for knowledge and its dissemination among other scientists which has been the guiding rule of the Royal Society. Long may it continue.

ON STREPTACHNE R. BROWN AND PHEIDOCHLOA GENUS NOVUM, TWO GENERA OF GRASSES FROM QUEENSLAND.

By S. T. Blake, M.Sc., Queensland Herbarium, Botanic Gardens, Brisbane.

(With Plates I. and II.)

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The genus *Streptachne* R.Br. Prodr. 174 (1810) was founded on a single species *S. stipoides* R.Br., l.c., though other plants have been referred to this genus by later writers. The interpretation of this genus and species has been a source of difficulty almost ever since, and in this paper an attempt is made to throw some light on the taxonomic and nomenclatural problems involved.

The data available for the taxonomic interpretation of *Streptachne stipoides* R.Br. are as follows:

1. Throughout the literature no specimens other than the type-gathering have been referred to this species.
2. Robert Brown, Prodr. 174 (1810), states that the specimens he saw were in the herbarium of Joseph Banks. The name of the species is merely listed (without a specific description) after the description of the genus, of which the most important phrase is "valvula *exterior* cylindraceo-involuta, arista terminali simplici inarticulata infra tortili" and the observation "Gramen facie Aristidae v. Stipae ab hac diversum arista cum valvula inarticulata."
3. Bentham, Fl. Austral. vii. 571-2 (1878), follows Brown and writes that the species is "only known from two very imperfect specimens, one in Herb. Banks, the other in Herb. R. Brown, each consisting of the summit of a stem without leaves, bearing a very slender and loose little-branched panicle of 5 to 6 in. Outer glumes 4 to 5 lines long, tapering into long fine points. Flowering glume narrow, glabrous, tapering into a very fine twisted and bent awn of $\frac{3}{4}$ in. Stamens 3." The locality is given as Endeavour River.
4. F. Mueller in Journ. & Proc. Roy. Soc. N.S. Wales xv. 237 (1882), cites *Streptachne* R.Br. as a synonym of *Stipa* L.
5. Domin, in Biblioth. Bot. xx. heft 85, 342 (1915), transfers the species to *Aristida* as *A. streptachne* n. nom. and thus describes the specimens: "besitzt fein zugespitzte, gleich lange circiter 11-13 mm lange, kahle Hüllspelzen, von denen die eine dreinervig, die andere einnervig ist. Die Deckspelze ist mit den Hüllspelzen fast gleichlang und geht . . . . in eine einfach, im unteren Teile spiralig gedrehte Granne über."

6. Hughes, in Kew Bull. 1922, 302 (1922), discusses the genus and its relationships with *Stipa* and concludes that it is distinct from this, but no reference is made to *Aristida*. According to her figures the lemma is much shorter than the glumes; the column is straight with regard to the lemma in one figure, bent both from the body of the lemma and from the awn in another figure. It is difficult to know from the figures whether the lemma is furrowed or not though a furrowed condition is suggested. The dimensions of the figures are: Glumes 71 and 63 mm.; body of lemma 42 and 46 mm.; column 27 mm.; awn 70 mm. The magnification of the figures is said to be 3.

7. Henrard, in Meded. Rijks Herb. Leiden liv.B (1928) and lviii. (1929), follows Domin in referring the species to *Aristida*. He did not see the specimens and his information seems to have come from a sketch and other data sent by A. B. Rendle. From his figure, key and description we get the following data: Glumes 11-13 mm. long, subequal or the lower slightly the longer, the lower 3-nerved, the upper 1-nerved; lemma terete, tubulous, up to 14 mm. long; column not bent from the body of the lemma, straight, strongly twisted, about 7 mm. long; awn slightly curved, up to 16 mm. long, not bent from the column.

8. The specimens were actually seen by Brown, Bentham, Domin, and Hughes, but the accounts of these authors are not in complete agreement. Brown gives no dimensions. Bentham gives the length of the glumes as 4 to 5 lines, which is rather shorter than Domin's 11-13 mm., but Bentham may have deliberately excluded the awnlets. The magnification of Hughes's figures is said to be 3; if the magnification is really 5 the dimensions agree with those given by Domin and Henrard. Mrs. Chase now writes me that there is a tracing of Miss Hughes's original drawings in the United States National Herbarium; they are of the same size as the published figures and are marked by Miss Hughes "5×". Also Henrard calls the lemma "terete, tubulous," which with him usually means that the margins of the lemma are convolute, but Brown states quite clearly that the margins are involute.

9. Henrard, in discussing *Aristida* sect. *Streptachne* (R.Br.) Domin, states that "if in *Aristida utilis*, a species with distinct but thin lateral awns, those lateral awns disappear, we have (as to the spikelets) before us the *Streptachne stipoides* of R. Brown."

10. *Aristida utilis* F.M.Bail. in Queensl. Agric. Journ. xviii. 340 (1907) was described from specimens collected by Mark Webb near Cooktown, the type-locality of *Streptachne stipoides*. The type consists of old specimens, of which the lemmas have prominent lateral awns 4-6 mm. long.

11. In more recent years an excellent series of specimens of *Aristida utilis* has been collected and a special study made of the large number of specimens constituting *Blake* 8149 and 13459. (See plate I, drawn from 8149; figs. 2-12 were drawn from spikelets from one and the same specimen).

These specimens show:

(*a*) Glumes equal or more or less unequal, in the latter case either the upper or the lower glume the longer; all variations to be seen in one and the same panicle; the length varies from 9 to 12 mm. in 8149, and 9 to 13·5 mm. in 13459.

(*b*) Lemma, column and awn nearly in a straight line (in immature spikelets) to variously bent and geniculate with respect to one another; lemma shorter than or as long as the glumes; awn straight or gently curved; the lemma varies in length from 6·5 to 13 mm. (usually); the column is 4·5-7 mm. long; the (central) awn varies from 9 to 15 mm. long.

(*c*) The lateral awns vary greatly; when well-developed up to 4 mm. long, very often greatly reduced or one or both entirely wanting. Figs. 9-12 of the plate illustrate stages in the reduction of the lateral awns in different spikelets from a single specimen; fig. 12 is that described for *Streptachne stipoides* R.Br., while fig. 9 represents the state found in the type of *Aristida utilis* F.M.Bail.

12. In one and the same panicle of many specimens of particularly *Blake* 8149 and 13459 occur spikelets which match those of the type-specimen of *Aristida utilis* (figs. 2 and 9) and other spikelets agreeing with all the available data concerning the type of *Streptachne stipoides* (figs. 3 and 12).

From the above data there seems no doubt whatsoever that *Aristida utilis* F.M.Bail. and *Streptachne stipoides* R.Br. are conspecific. In general the longer the panicle the greater the tendency to produce prominently 3-awned lemmas, and the smaller the panicle the greater the tendency for the greater number of spikelets to have the lateral awns much reduced or absent. As a rule the panicle is about as long as the remainder of the culm. It is noteworthy that the panicles of the type of *Streptachne* are according to Bentham 5-6 in. long* while the usual length in *A. utilis* is at least twice this.

Banks and Solander were at Endeavour River between June 17th and August 5th, 1770, an unfavourable time of the year for collecting grasses in this region. I visited the area at the same season (July 30th to August 2nd) in 1943 and found *Aristida utilis* very abundant, but the plants had shed nearly all their florets. A search for plants without lateral awns was undertaken, and it was evident that a considerable variation occurred. Only a very few specimens in over-mature condition or with spikelets arrested in development were procurable, and though some spikelets have very tiny lateral awns there are none with them entirely absent. The type-specimens of *A. utilis* from the same locality were also collected rather late in the season (May). So it is possible that none of these specimens gives a true idea of the species.

The generic position of the species has now to be considered. Hughes, l.c., has given sufficient reason for not uniting *Streptachne* with *Stipa*; the absence of an articulation between awn and lemma is exclusive, besides the frequent presence of lateral awns, which was

* Mrs. Chase writes me that in the United States National Herbarium there is a tracing of these plants sent by Miss Hughes, and the panicles measure 23 and 24 cm. long, the two lower branches of each 6·5 and 7 cm. long.

unknown to her. As Domin, l.c., has pointed out, it is not possible to separate *Streptachne* from *Aristida* on the character of the reduced lateral awns, as there is a complete series of species in which the lateral awns are more and more reduced until they completely disappear. He reduces *Streptachne* to a section of *Aristida*. Henrard, op. cit. lviii. 142, discusses the question again and after mentioning some American species of *Aristida* referred to *Streptachne* by Humbold, Bonpland and Kunth, states "If we compare these species with the genus, described by Brown, it is impossible to find differences in the spikelet-characters and we can find transitions between plants with short lateral awns and others where the lateral awns are quite obsolete and absent"; on p. 143 he goes on "The section *Streptachne* is not a very natural one and it is impossible to limit it sharply. It is probably better to unite *Streptachne* and *Chaetaria*, but for practical reasons I have separated them in this work."

To the above observations it may be added that the general appearance of the species is that of *Aristida* (as was noted by Brown), the appearance, texture and nervature of the glumes and lemmas are quite those of this genus, as is also the structure of the awns. The small palea and furrowed grain are likewise found in undoubted species of *Aristida*. The column is frequently bent away from the lower part of the lemma, and this feature appears not to be found in other sections of the genus, but it is not constant even in the type of *Streptachne stipoides*. The column of this species is a prolongation of the lemma proper, with 3 nerves running one into each awn.

There are undoubted species of *Aristida* in Queensland with such a column between the body of the lemma and the awns, but all have unfurrowed lemmas with convolute margins; they are *A. psammophila* Henr., *A. macroclada* Henr., *A. Schultzii* Mez, *A. Warburgii* Mez, *A. intricata* S. T. Blake, *A. latifolia* Domin, *A. holathera* Domin and *A. perniciosa* Domin. Of these *A. perniciosa* rather closely resembles *Aristida utilis* in foliage, in the elongated trailing uppermost internode, structure of the panicle, and in the texture, nervature and more or less in the shape of the glumes; the lateral awns, too, are decidedly shorter than the central awn. The points of resemblance to *Aristida* are so many and so important, while the two points of difference—the reduced lateral awns and the oblique column—are so inconstant in expression, that there seems no doubt that Domin and Henrard are right in treating *Streptachne stipoides* R.Br. as a species of *Aristida*.

Since *Streptachne stipoides* R.Br. and *Aristida utilis* F.M.Bail. are to be regarded as conspecific, the following data must be considered before it is possible to decide the legitimate name of the species under *Aristida*:

1. When *Streptachne stipoides* is transferred to *Aristida* the epithet *stipoides* becomes illegitimate in the new position owing to the earlier homonyms *Aristida stipoides* Lam. Tab. Encycl. & Meth. 157 (1791) and *A. stipoides* R.Br. Prodr. 174 (1810).

2. F. Mueller, in Journ. & Proc. Roy. Soc. N.S. Wales xv. 237 (1882) cites *Streptachne* R.Br. as a synonym of *Stipa* L. but without remark and without transferring any species.

3. F. Mueller in First Census 133 (1882) has the following entry under *Stipa*:

> S. Streptachne, F.v.M. in journ. R.S. of N.S.W. 237 (1881).... Q.—B.fl. VII, 572.

4. Domin, in Biblioth. Bot. xx. heft 85, 342 (1915) transfers the species to *Aristida* as *A. streptachne* n. nom. citing *Streptachne stipoides* R.Br. Prodr. 174 (1810) and *Stipa Streptachne* F.Muell. in Journ. & Proc. Roy Soc. N.S. Wales xiv. 237 (1881)*; First Census 133 (1882) . . . . etc.

5. Mueller's reference in the First Census to Journ. & Proc. N.S. Wales xv. has no nomenclatural significance, for there is no reference, expressed or implied, to the combination *Stipa Streptachne* nor to the species *Streptachne stipoides*. The formula "Q. B.fl. VII, 572" in the First Census means that the species mentioned occurs in Queensland and was described in Bentham's Flora Australiensis vii. 572. The only Queensland plant described by Bentham on this page is *Streptachne stipoides* R.Br. where a reference is given to R.Br. Prodr. 174†. According to some recent interpretations of Art. 37 of the International Rules by Airy-Shaw (Kew Bull. 1938, p. 256) and Sprague (Kew Bull. 1939, pp. 322-3) Mueller's formula must be regarded as an indirect reference to *Streptachne stipoides* R.Br. Prodr. 174, and this would validate the publication of the combination *Stipa Streptachne* F.Muell.

6. Though *Stipa Streptachne* F.Muell. is a valid combination, it is illegitimate, since the epithet *stipoides* should have been used, this having priority (as an epithet in the required position) and had not previously been used under *Stipa* (Art. 54).

7. According to Art. 60, the publication of an epithet in an illegitimate combination must not be taken into consideration for purposes of priority.

8. According to Art. 69, Domin was at liberty to use the epithet *Streptachne* when transferring the species to *Aristida* (since the epithet *stipoides* under *Aristida* would produce an illegitimate combination, namely a later homonym) though he was not obliged to do so, but the combination *Aristida streptachne* then has to be treated as a *new name* (as was done by Domin), not as a new combination (as was done by Henrard), so that the date of the epithet would date from the combination under *Aristida,* namely 1915.

9. The epithet in *Aristida utilis* dates from the date of publication of this combination, namely 1907.

10. So long as *Streptachne stipoides* and *Aristida utilis* are considered conspecific, *Aristida utilis* must be accepted as the legitimate name of the species.

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* This volume is xv., the journal for the year 1881, published in 1882, so that Mueller's citation of merely the year 1881 is misleading; Domin added the number of the volume *published* in 1881, apparently without checking the reference.

† Miss J. W. Vickery drew my attention to this nomenclatural significance of Mueller's formula.

Following is the revised synonymy and description of the species:

Aristida utilis *F.M.Bail.* in Queensl. Agric. Journ. xviii. 340 (1907), Compreh. Catal. 622 (1913), but not the reference and figure in Queensl. Agric. Journ. xxx. 316, t.46 (1913)*; Domin in Biblioth. Bot. xx. heft 85, 341 and t.15, f.15-17 (1915); Henr. Meded. Rijks Herb. Leiden liv.B, 651 (1928), lviii. 143-4, t.55 (1929).

Streptachne stipoides R.Br. Prodr. 174 (1810); Benth. Fl. Austral. vii. 572 (1878); F.M.Bail. Queensl. Fl. vi. 1878 (1902), Compreh. Catal. 623 (1913); Hughes, Kew Bull. 1922, 302 (1922); not *Aristida stipoides* Lam. nor *A. stipoides* R.Br.

Stipa Streptachne F.Muell. First Census, 133 (1882), Sec. Census 223 (1889); F.M.Bail. Syn. Queensl. Fl. 650 (1883), Catal. Pl. Queensl. 56 (1890); *nomen illegit.*

Aristida streptachne Domin in Biblioth. Bot. xx. heft 85, 342 (1915). Henr. Meded. Rijks Herb. Leiden liv.B, 597 (1928), lviii. 147, t.57 (1929).

A closely tufted perennial grass with intravaginal innovations. Culms usually oblique to more or less straggling, rarely more or less erect, usually straight in the lower part, including the panicle usually 6-10 dm. long, very slender, terete, simple or sparsely branched, 3-5-noded, the nodes not prominent, the uppermost internode very long and up to 45 cm. long, finely striate, scabrid but glabrous, the others more or less subequal but irregular, densely pilose with appressed rather long silky hairs. Leaf-sheaths usually shorter or the lowermost longer than the internodes, tight, terete, striate, minutely scaberulous, sometimes with a few long fine hairs near the margin in the lower part and the scarcely prominent nodes, otherwise glabrous; ligule a minutely but densely ciliolate rim in all about 0·25 mm. long; auricles indistinct, more or less bearded; collar glabrous, smooth; blades more or less flexuous with the old ones strongly so and more or less coiled and persistent, tapering to a filiform point, at first conduplicate-terete, soon becoming flat or somewhat concave, the upper surface and margins decidedly scaberulous and sometimes with a few long fine hairs towards the base, the lower surface less distinctly scaberulous to nearly smooth, for the most part 10-20 cm. long, 1-1·4 mm. wide, the uppermost often not much shorter than those below. Panicle long-exserted, rather scanty, narrow, contracted to rather loose, occupying about half the length of the plant; common axis about 5-8-noded, very slender, semi-terete, striolate, scaberulous below, more scabrous above, glabrous except for a few hairs (sometimes very short) at the axils of the branches; primary branches solitary or binate, the longer (when binate) with the spikelets included about as long as the internodes of the axis, filiform-trigonous, suberect or slightly spreading, straight, scabrous, naked for some distance when binate or if solitary then sparsely divided from close to the base, up to 8·5 cm. long, each bearing with its divisions up to about 10 spikelets; pedicels filiform-trigonous, slightly thickened at tip, scabrous, sometimes with a few long fine white hairs, the lateral ones about 1·5-5 mm. long, the terminal ones longer, up to 13 mm. long. Spikelets purplish to pallid, not much gaping. Glumes subequal or one or the other distinctly the longer though rarely by so much as 2 mm., glabrous, rather firm, straight, narrow-lanceolate, shortly awned, one or the other or sometimes both narrowly contracted or even minutely

* These notes and figure refer to specimens of *A. perniciosa* Domin.

bilobed below the awnlet, otherwise acute, in all 9-13·5 though usually 10-12 mm. long including the awnlet of 1-3 mm.; lower glume 3- or sub-5-nerved, finely scabrous on the keel, elsewhere smooth or nearly so; upper glume 1-nerved, smooth. Lemma very slender, subcylindrical in outline, furrowed with involute margins, widest near base and slightly tapering upwards, finely punctulate, more or less distinctly scabrous in upper part and passing gradually into the column, together with the callus usually 7-12 mm. long; callus very small, about 0·5 mm. long, obtuse, rather densely bearded with fine hairs up to 1 mm. long. Column slender, scabrous, twisted, straight in direction, oblique or erect in relation to the body of the lemma, mostly 4·5-7 mm. long. Central (or only) awn slender, firm, straight or slightly curved, bent at an angle from the column, scabrous, mostly 9-15 mm. long; lateral awns extremely fine, very short, rarely more than 4 mm. though up to 6 mm. long, frequently minute or one or both absent. Palea 1 mm. long. Anthers 1·5 mm. long. Grain grooved throughout its length, about 5 mm. long and 0·3 mm. wide.

Queensland.—Cook District: Endeavour R., June-August, 1770, *Banks & Solander* (type of *Streptachne stipoides*; drawings only seen); near Cooktown, May, 1907, *Webb* (type of *Aristida utilis*); Cooktown, *Pollock*; Cooktown, on rocky hillsides in open forest, July 31st, 1943, *Blake* 15077; Chillagoe, on granite hill-slopes, ca. 1450 ft., April 4th, 1938, *Blake* 13632; Mt. Molloy, granite hills, 1200 ft., April 11th, 1932, *Brass* 2453; Mareeba, in rather bare places in Eucalyptus forest, ca. 1300 ft., March 27th, 1938, *Blake* 13459. North Kennedy District: Townsville, on Castle Hill, on exposed slopes and in Eucalyptus forest, March 22nd, 1935, *Blake* 8149, and on Castle Hill on sandy soil in open forest and on exposed slopes, June 7th, 1934, *Blake* 5946; between Stuart and Alligator Creek Meatworks, S. of Townsville, scattered or in societies, May, 1942, *L. S. Smith* T.2; Valley Creek near Proserpine, *Michael* 915. Port Curtis District: Rosedale, common on summit of granite mountain, May 10th, 1936, *Dovey* 829.

New Guinea.—Papua: Near Moresby, in savanna-forest, August, 1944, *Hilton*.

Under the original description Bailey states that "the long smooth peduncles are being used in the manufacture of hats" but the grass is no longer being thus utilised. In Compreh. Catal. 622, Bailey gives "hat grass" as a vernacular name. No information is available as to its value for grazing, but it appears to be but little eaten, and grows only on poor country.

A. spuria *Domin*, l.c., 341 (1915), Henr. op. cit. liv.B 585 (1928) and lviii. 149-50, t.58 (1929) is a species very closely allied to *A. utilis* showing a parallel degree of reduction of the lateral awns. It differs from *A. utilis* by having glabrous internodes, fine convolute-setaceous leaves, shorter and more or less erect uppermost internodes, usually shorter panicle-branches and rather smaller glumes with shorter awnlets. On the average the glumes are 6-8 mm. long, subequal or one or the other very slightly the longer, with awnlets of up to 1 mm., the lower gradually very acute, the upper acute but somewhat contracted below the awnlet, the lower prominently 3- or 5-nerved and scabrous on the nerves, the upper 1-nerved somewhat scabrous on the nerve; the lemma is furrowed with involute margins, usually 8-10 mm. long, rarely slightly longer or shorter; the column is mostly 5-7 mm. long, rarely so short as 4 mm.;

the central awn is usually 9-13 mm. long, rarely so short as 7; the lateral awns are up to 4 mm. long, but are frequently very much smaller or insignificant to absent.

The type-specimens were collected by Domin on Castle Hill, Townsville, in February, 1910, but appear to have been seen by no other botanist. Henrard has taken *White* 1614 from the same locality as belonging to Domin's species; *Blake* 8349, also from the same locality, agrees. Domin describes the length of the spikelet-parts as follows: glumes 6-8 mm.; lemma with callus 6·5-7 mm.; column about 3·5 to nearly 4 mm.; central awn about 7-9·5 mm.; lateral awns up to 2 mm. Domin also describes his plants as annual, with the habit of *A. arenaria* Gaud. I think that there is no doubt that Henrard is correct in his interpretation of Domin's species, but it would appear that Domin had young plants with apparently smaller spikelets than usual, or perhaps they were not quite mature. I have found spikelets with the dimensions given by Domin, but the great majority have longer lemmas and awns, with the dimensions given above. The plants are perennial, frequently with branched culms.

The following collections are represented in the Queensland Herbarium:—

Queensland.—Burke District: Near source of Poison Creek, about 90 miles N. of Hughenden, in Eucalyptus (box) forest on stony ground, ca. 2750 ft., April 12th, 1935, *Blake* 8608. North Kennedy District: Castle Hill, Townsville, March, 1922, *White* 1614; Townsville, upper slopes of Castle Hill, among rocks, 700-1000 ft., March 30th, 1935, *Blake* 8349; Magnetic Island, on low sandy ridge in Eucalyptus forest, March 24th, 1935, *Blake* 8214; Hayman Island, common on hillsides in open Eucalyptus forest, June 11th, 1934, *White* 10223. Leichhardt District: Minerva, N. of Springsure, on open dry ridge on very shallow stony, reddish-brown silt-loam, ca. 1000 ft., March 8th, 1935, *Blake* 7971. Port Curtis District: Rosedale, not uncommon on summit of granite mountain, May 10th, 1936, *Dovey* 830. Moreton District: Little Mt. Edwards, tufted grass very common on bare trachyte slopes and among stunted Leptospermums, March 30th, 1934, *Everist* 547; Mt. Edwards, on cliffs above the northern side of the gorge, April 1st, 1934, *Everist* 609.

The other species which have been referred to *Streptachne* have been discussed by Hughes, l.c., p. 303. To these remarks it should be added that *S. ramosissima* (Trin.)Trin. and *S. verticillata* (Nees)Trin. & Rupr. rightly belong to the genus *Stipa* as was pointed out by Henrard, op. cit. lviii. 142, and not to *Muehlenbergia* as indicated by Hughes, l.c., nor to *Dichelachne* as earlier suggested by Hughes, op. cit. 1921, 28 (1921). Of the American species, I have seen specimens of *Aristida ternipes* Cav. (*Streptachne scabra* H.B.K., *S. tenuis* H.B.K.), *A. jorullensis* Kunth (*Streptachne pilosa* H.B.K.) and the comparable *A. Orcuttiana* Vasey. These represent an evolutionary trend of reduction from characteristic species of *Aristida sect. Chaetaria* parallel to what has taken place in the Australian group. The groups from the two continents are not particularly closely allied, and, for that matter, *A. Orcuttiana* appears not to be very closely allied to the other two American species.

Streptachne indica Buese ex De Vriese, Pl. Ind. Bat. Or. 99 (1856), Miq. Fl. Ind. Bat. iii. 751 (1859), from Java, was not mentioned by Domin, Hughes or Henrard, and I have found no further clue to its

identity. The characters given (taken from Miquel, l.c., apparently a copy of the original description) of "nodis pilosis," "spiculae basi fasciculo pilorum brevium cinctae," "valvula inferior glumis paullo brevior leviter bidentata et in aristam scabram . . . . terminata," suggest a relationship remote from the species discussed above, and in the absence of the type-specimens it is useless to guess at what it might be. There is no mention of it in Koorders' Exkursionsflora von Java (1912).

Four points arise from the inquiry into the nomenclature of *Streptachne stipoides* under *Aristida*.

1. It does seem unfortunate that illegitimate though valid names are excluded from considerations of priority. A more logically practical method of dealing with matters of priority would seem to be along the lines suggested by Furtado (particularly in Gardens' Bull., Straits Settlements, xi. 1-30: 1939), according to which names are classified according to validity, priorability and legitimacy. Validly published names may be priorable whether they are legitimate or not, and on transfer to another genus the oldest valid epithet priorable in the new position must be employed and such a transfer becomes a new combination. If such a procedure were incorporated in the International Rules, *Stipa Streptachne* would be a priorable name, although illegitimate and its epithet would have to be taken into consideration when the species is transferred to *Aristida*. It would be then compulsory to use this epithet (dating from 1882) and the resulting *new combination A. Streptachne* (F.Muell.) Domin would be the legitimate name for the species.

2. Art. 44 states that "The name of a species . . . . is not validly published unless it is accompanied (1) by a description of the group, or (2) by the citation of a previously and effectively published description of the group under another name, or (3) by a plate or figure with analyses showing essential characters; . . . . " The publication of the name of the species *Streptachne stipoides* does not conform to any of these conditions, for, as previously stated, (p. 11), the name is merely listed after the description of the genus. Yet the publication is quite unequivocal, is far more satisfying than many a "citation of a previously and effectively published description" and nobody seems ever to have questioned the validity of this form of publication. Art. 5—"In the absence of a relevant rule . . . . established custom must be followed"—can be invoked, but surely such a case should be definitely covered by the Rules.

3. In the Rules, no limits are set as to the interpretation of a "citation of a previously and effectively published description." In the case of *Stipa Streptachne* F.Muell., validity is allowed merely because no other Queensland plant happens to be described on the cited page of the Flora Australiensis. Can a reference be valid if no name of a taxonomic group is cited ? or again if there is no reference to the original description of a group ?

4. Should validity be denied to the combination *Stipa Streptachne* F.Muell. in First Census, 133, on the grounds of absence of description and imperfect reference, attention must be paid to F. M. Bailey's Syn. Queensl. Fl. 650 (1883), where under *Stipa* four sentences evidently taken from Bentham's description of *Streptachne stipoides* follow the name *S. Streptachne* F.v.M. There is no other reference. According

to the letter of Art. 44, the provision of this description would validate the publication of the name *Stipa Streptachne,* but the position then arises that the publication of a name can be validated by reason of author having published a "description" of a species of which he had seen no specimen.

Pheidochloa *S. T. Blake*; genus novum affine *Eriachnae* R.Br., a qua gluma superiore inferiore duplo longiore, anthoeciis subteretibus antice profunde sulcatis callo angusto pungente praeditis, caryopsi angusta marginibus incurva itaque sulcata, culmi internodio penultimo brevissimo praecipue differt.

Spiculae a latere compressae, ambitu anguste lanceolatae, aristatae, vel in racemo vel in ramis paniculae depauperatae ortae; rhachilla brevis glabra, supra glumas et inter anthoecia disarticulans, supra haec haud producta. *Anthoecia* 2, contigua, a glumis obtecta, bisexualia, anguste fusiformia, antice sulcata; callus angustus, pungens, barbatus, pro ratione longus. *Glumae* persistentes, valde inaequales superior duplo longior, a latere visae oblique lanceolatae, acutae, muticae, vix carinatae, dorso herbaceo-membranaceae manifeste 7-nerves, marginibus hyalinae. *Lemmata* subsimilia, subteretia marginibus involuta, explanata oblonga obtusa, tenuiter cartilaginea, tenuiter 7-nervia, plus minusve pubescentia, apice integra in aristam longam scabram leviter flexuosam haud tortam desinentia. *Paleae* lineares, hyalinae, manifeste bicarinatae. *Lodiculae* 2, parvae, angustissime lineares, hyalinae. *Stamina* 2. *Ovarium* glabrum; styli distincti; stigmata plumosa, haud exserta. *Caryopsis* linearis marginibus incurva itaque antice sulcata; scutellum $\frac{1}{3}$ caryopseos aequilongum; hilum lineare caryopsi fere aequilongum.—*Gramen* annuum, gracillimum, caespitosum, parvum; culmi sursum ramosi, internodio penultimo brevissimo; foliorum laminae setaceae, convolutae, prope basin angustatae, 7-nerves; ligulae ad seriem ciliorum brevium redactae.

Species unica, Queenslandiae tropicae incola.

Pheidochloa gracilis *S. T. Blake*; species nova, adhuc unica.

Gramen annuum, usque ad 30 cm. altum. *Culmi* fasciculati, filiformes, plus minusve flexuosi, obliqui vel erecti, plerumque 3-5-nodes raro 2- vel 6-nodes, glabri laevesque, e nodis superioribus ramosi, internodio penultimo quam ceteris (imo interdum excepto) breviore. *Folia* pauca; vaginae arctiusculae vel sursum admodum hiantes, teretes, striatae, glabrae, laeves, internodiis breviores vel superiores multo breviores; ligulae ad marginem brevissime ciliolatum redactae; laminae setaceae, convolutae, suberectae, strictae vel plus minusve recurvae, basin versus angustatae atque vaginis multo angustiores, 0·3-4 cm. longae, usque ad 0·5 mm. latae vel explanatae usque ad 0·9 mm. latae, apice obtusae, 7-nerves nervis subtus prominulis, marginibus incrassatae, subtus pilis paucis longis tenuibus e tuberculis ortis pro more ad margines prope basin praeditae, ceterae glabrae laevesque. *Inflorescentia* paniculata vel racemosa e spiculis 2-6 constructa, aristis exclusis 1·5-3·2 cm. longa, longe exserta; axis communis, ramis (ubi adsint), pedicellique trigono-filiformes, parce ciliata; rami infra pedicellos brevissimi, erecti; pedicelli sub apice leviter incrassati, erecti, terminales usque ad 5 mm. longi. *Spiculae* lineari-lanceolatae, tandem leviter hiantes, aristis exclusis 10-13 mm. longae, erectae appressaeque. *Glumae* pallidae, acutae, muticae, prominule 7-nerves, glabrae, laeves; inferior anguste ovata, 4·5-5 mm. longa; superior duplo longior, lanceolata, 9-11 mm. longa. *Anthoecia* contigua, lineari-fusiformia, antice

profunde sulcata. *Lemmata* pallida dorso lateribusque in majore parte breviter pubescentia, apicem versus glabra, nervis nonnullis saepe breviter setosa, callo incluso 3·7-4·5 mm. longa; callus angustissimus pungens, breviter barbatus, 1-1·1 mm. longus; arista purpurea, basi admodum constricta, setacea, admodum applanata, 3·3-3·8 cm. longa. *Paleae* muticae lemmatibus subaequilongae, inter carinas elevatas planae, glabrae. *Antherae* ovatae, minimae, 0·15-0·2 mm. longae. *Lodiculae* 0·5 mm. longae, tenuissimae. *Caryopsis* linearis, dorso convexa, 2 mm. longa.

QUEENSLAND.—Cook District: About 40 miles N.W. of Mungana, in *Melaleuca* forest on fine whitish sand, abundant, April 8th, 1938, *Blake* 13732 (TYPE); N. of Chillagoe, near Walsh R., in dwarf *Melaleuca* forest on sand, ca. 1000 ft., April 2nd, 1938, *Blake* 13592.

A delicate annual grass (plate II) with filiform culms, short setaceous leaves and long-exserted inflorescences of few, 2-flowered spikelets with long purple awns. Most culms bear a short floriferous branch from the penultimate node (topmost but one); the internode above (penultimate internode) is much shorter than those immediately below, often the shortest on the culm, and this feature gives a peculiar facies to the plant. Occasionally a branch is also borne at the antepenultimate node, and in this case the antepenultimate internode is rather shorter than the one immediately below, though much longer than the penultimate. The inflorescence, when consisting of up to 4 spikelets, is a raceme, but when 5 or 6 spikelets are present the lower one or two branches bear a shortly pedicellate lateral spikelet, so that a depauperate panicle is the result.

On account of the 2-flowered spikelets and the lemmas with a single terminal bristle-like awn this new genus is most closely allied to *Eriachne* R.Br., but the extraordinarily elongated upper glume (twice as long as the lower), the subterete florets deeply furrowed in front and with a pungent slender callus, the prominently inrolled (not merely incurved) margins of the lemma, the elevated keels of the palea and the peculiar very narrow grain are all quite distinctive features. The grain of *Eriachne*, so far as has been ascertained, is more or less obovate in outline and flat or nearly so on the anterior face. In *E. melicacea* F.Muell. the grain appears to be constantly concave along the anterior face, but it is very different from that of *Pheidochloa* which has the margins incurved leaving a very deep furrow and giving a crescentic-reniform appearance in transverse section. The lodicules are extremely fine and delicate. The anthers are extraordinarily small and are always to be found tangled up with the stigmatic hairs in mature spikelets; the spikelets are very evidently cleistogamous. Small anthers associated with cleistogamy have been found in *Eriachne triseta* Nees, *E. Armitii* F.Muell. ex Benth., and *E. stipacea* F.Muell. var. *hirsuta* Hartley. Most species of this genus have relatively large anthers which are laterally exserted during anthesis; they are usually 3 in number, though 2 only in some of the small species such as *E. ciliata* R.Br. and *E. filiformis* Hartley. Vegetatively *Pheidochloa* differs from *Eriachne* (except *E. Dominii* Hartley) in the very short penultimate internode of the culm and in that the leaf-blade is decidedly narrowed to the base from shortly above, but this latter character is not readily discernible unless the leaf-blade is artificially unrolled and flattened out.

The position of the genus in the family is not clear, though *Eriachne* has usually been placed in the *Aveneae*. C. E. Hubbard (Hook Ic. Pl.

under t.3418: 1940) has pointed out that the *Aveneae* may be divided into two groups distinguished partly on the nature of the awn. In the typical group (*Aveneae* subtribe *Euaveneae* Beck) the awn is dorsal and its column often subterete, or at least not flattened or laterally winged. The column is formed by the continuation of the middle nerve and not by the splitting of the lemma into three segments. On the other hand, in the second group (*Aveneae* subtribe *Danthonieae* Beck), the lemmas are usually two-lobed, and the awn when present arises in the sinus of the lobe. Here the column of the awn is flattened and its formation is due to the gradual splitting of the apex of the lemma into three segments.

Eriachne and *Pheidochloa* differ from each of these groups, for in these genera the awn is a continuation of the fusion of all the nerves of the unlobed lemma, and perhaps they are as well placed in the *Festuceae*.

The name *Pheidochloa* is derived from φειδός, sparing, thrifty; and χλόα grass. It refers to the scanty inflorescence, 2-flowered spikelets, the two minute anthers and the very fine and thin lodicules.

Both collections are from similar types of country—ill-drained sandy land supporting an open dwarf-tree community of *Melaleuca* spp. associated with chiefly small annual grasses and Cyperaceae belonging to the genera *Eriachne, Ectrosia, Heterachne, Schizachyrium, Thaumastochloa* and *Fimbristylis*.

EXPLANATION OF PLATES.

PLATE I.—*Aristida utilis* F.M.Bail. drawn from *Blake* 8149; figs. 2-12 from same specimen.

FIG. 1, plant, *natural size*; 2, 3, spikelets, × 3, the former with "normal" glumes and well-developed lateral awns, the latter with "inverse" glumes and the lateral awns absent; 4-8, details of spikelet, × 6:—4, 5, glume tips from two spikelets, *a*, upper, and *b*, lower; 6, lemma, front view; 7, palea; 8, flower with lodicules separated; 9-12, top of column with base of awn, from four spikelets, showing variation in development of lateral awns, × 15.

PLATE II.—*Pheidochloa gracilis* S. T. Blake, gen. nov., sp. nov., drawn from *Blake* 13732 (type).

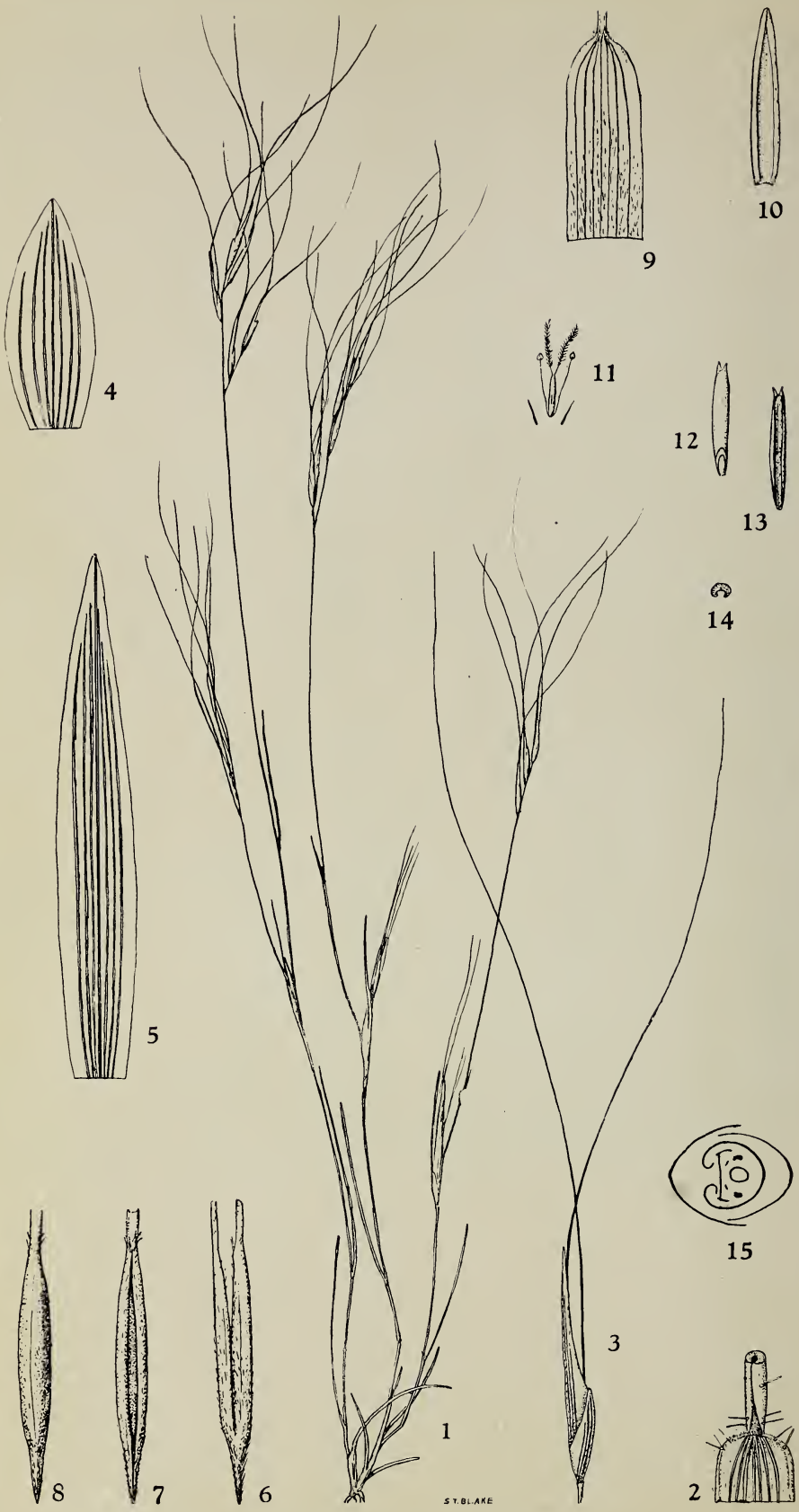
FIG. 1, plant, *natural size*; 2, ligule with top of leaf-sheath partly flattened and base of blade; 3, spikelet; 4, lower glume; 5, upper glume; 6, florets, side view, greater part of awns removed; 7, 8, floret from front and back respectively; 9, lemma, expanded, from the back; 10, palea from in front; 11, flower with the lodicules separated; 12, 13, grain from back and front respectively; 14, transverse section of grain; 15, diagram of spikelet.—Fig. 3 × 3; figs. 2, 4-14 × 8.

ERRATUM.

For Plate II., fig. 15 read

15

Aristida utilis F.M.Bail.



Pheidochloa gracilis S. T. Blake, gen. nov., sp. nov.

SOME PERMIAN FORAMINIFERA FROM EASTERN AUSTRALIA.

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(With Plate III.)

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INTRODUCTION.

Recent investigations of the Permian rocks of Queensland and New South Wales have shown that microfossils are well distributed in them. Permian foraminifera have been described by Howchin (1893, 1895), Chapman and Howchin (1905), Etheridge Junr. (1906), Parr (1940) and Crespin and Parr (1940), from deposits in New South Wales, Tasmania, Western Australia and Northern Territory, but none has been previously listed from Queensland.

Four new species are described in the present paper and notes are given on previously described forms. The Queensland material examined includes rocks collected by Dr. K. Washington Gray during his investigations in the Springsure area for Commonwealth Oil Refineries Ltd., from rocks collected from the same area by geologists of Oil Search Limited, and from cores and cuttings from the Arcadia Bore, 84 miles north of Roma. The New South Wales specimens are mainly from rock collections made by Dr. Washington Gray and geologists of Oil Search Limited, in the Hunter River District, and drill cuttings from the Kulnura Bore, parish Kooree, county Northumberland (Raggatt and Crespin, 1940).

In Queensland, the foraminifera occur in beds belonging to the Middle Bowen and Lower Bowen Series, and in New South Wales to the Upper Marine and Lower Marine Series.

The state of preservation of the tests varies, many of them being crushed and distorted. Some are brownish in colour, while those from the carbonaceous shales in the Kulnura Bore are almost black.

The new species of foraminifera herein described are:—*Nodosaria serocoldensis, Nodosaria springsurensis, Dentalina grayi,* and *Frondicularia parri.*

All specimens are in the Commonwealth Palaeontological Collection at Canberra. The plate accompanying this paper has been prepared by Mr. F. Canavan, M.Sc., of the Mineral Resources Survey, Canberra.

DESCRIPTION OF SPECIES.

Genus HYPERAMMINOIDES Cushman and Waters, 1928.

Hyperamminoides acicula Parr, (Pl. III., Fig. 1.)

Hyperamminoides sp. cf. *proteus* (Cushman and Waters), Crespin and Parr, 1940, p. 301, pl. xii, figs. 4*a, b;* 5*a-c.*

Hyperamminoides acicula Parr, 1940, p. 105, pl. i, figs. 4, 5; pl. ii, fig. 4.

Observations.—*H. acicula* is the commonest foraminiferal species in the Permian rocks of Australia, but few complete tests are available. The figured specimen from the Springsure district, Queensland, is incomplete. It is a slender form and resembles that figured by Parr (pl. 1, fig. 5, 1940) from the *Lingula* beds, Wandagee Station, Western Australia. The majority of specimens from Eastern Australia are stouter and usually more flattened than the type. Length of plesiotype, 1.21 mm.; greatest width, 0.22 mm.

Occurrence.—Plesiotype (Comm. Pal. Coll. No. 271): Dry Creek, "Inglelara" property, Springsure, Queensland (Middle Bowen Series). Other Localities.—*Queensland.* Middle Bowen Series: lower part of exposure, Argus's Selection, Springsure; Arcadia Bore, at 2,070-2,075 feet. Lower Bowen Series: Aldbaran Creek, 4 miles N.E. of Mt. Catherine, 30 miles W. of Rolleston; Watershed between Little Gorge and Cabbage Tree Creeks near Springsure; 3 miles from Cracow on road to Theodore.

New South Wales. Upper and Lower Marine Series: localities in the Hunter River District listed by Crespin and Parr (1940). Upper Marine Series: Balmain Bore, City of Sydney, between 4,750 and 4,845 feet; Kulnura Bore at various depths between 3,865 feet and 4,465 feet; Bore J, Coorabin, 55 miles N.W. of Albury, at 384 feet.

Lower Marine Series: Kulnura Bore, between 4,790 feet and 6,019 feet.

Genus AMMODISCUS Reuss, 1816.

Ammodiscus multicinctus Crespin and Parr (Pl. III, Fig. 2.).

Ammodiscus multicinctus (Crespin and Parr, 1940, p. 303, pl. xii, figs. 1*a, b.*

Observations.—This small species of *Ammodiscus* was described from beds belonging to the Lower Marine Series, in a railway cutting 4 chains west of Farley Station, Hunter River District, New South Wales. The species is well represented in other Permian deposits in that district and also in those around Springsure, Queensland. The figured specimen is from this latter area. Diameter of plesiotype: 0.52 mm.

Occurrence.—Plesiotype (Comm. Pal. Coll. No. 272): Cattle Creek below Waterfall, 14 miles S.E. from Springsure, Queensland (Lower Bowen Series).

Other Localities.—*Queensland.* Middle Bowen Series: Dry Creek, "Inglelara" property, Springsure; Gully on Argus's Selection, Springsure; Arcadia Bore, 2,070-2,075 feet. Lower Bowen Series: Staircase Gully below old Rolleston road cutting: 3 miles from Cracow on road to Theodore.

New South Wales. Upper and Lower Marine Series: localities in the Hunter River District listed by Crespin and Parr (1940). Upper Marine Series: Kulnura Bore at 4,020 feet.

Genus CALCITORNELLA Cushman and Waters, 1928.

Calcitornella stephensi (Howchin) (Pl. III, Fig. 3.).

Cornuspira sp. Jones, 1882, p. 6.

Nubecularia lucifuga Defrance var. *stephensi* Howchin, 1894, p. 345, Pl. x*a*, xi*a*.

Nubecularia stephensi Chapman and Howchin, 1905, p. 5, pl. i, figs. 1, 2; Etheridge Junr., 1907, p. 13, pl. xii, fig. 11.

Calcitornella stephensi Chapman, Howchin and Parr, 1934, p. 187; Parr 1940, p. 108.

Observations.—*C. stephensi* was originally described by Howchin from a limestone at Piper River, Tasmania, where it is recorded as being "extremely abundant." It is also a common form in the Permian rocks in Western Australia. Etheridge Junr. records the species from a bore at Port Keats, Northern Territory, at the depth of 555-574 feet, where it is associated with abundant bryozoa and brachiopoda fragments. The specimen figured in this paper illustrates the surface that has been attached to the rock matrix. Greatest diameter, 1.12 mm.

Occurrence.—Plesiotype (Comm. Pal. Coll. No. 273): Pokolbin, Hunter River district, New South Wales (Lower Marine Series). Other Localities.—*Queensland.* Lower Bowen Series: Mt. Hope, 20 miles S. of Springsure; N. bank of Cattle Creek, 14 miles S.E. of Springsure, in shelly mudstone; in Cattle Creek below Waterfall, near Springsure.

New South Wales. Lower Marine Series: Hunter River District.—Cranky Corner; Road Cutting, Jackson's Hill.

Tasmania. Lower Marine Series: Piper River, N.W. of Karoola.

Genus AMMOBACULITES Cushman, 1910.

Ammobaculites woolnoughi Crespin and Parr (Pl. III., Fig. 4).

Ammobaculites woolnoughi Crespin and Parr, 1940, p. 304, pl. xii. figs 2*a, b;* 3 *a, b.* Parr, 1940-1941, p. 108, pl. i., fig. 11.

Observations.—The figured specimen is identical with the type which was described from the beds along the Farley road, 300 yards N.E. of Farley Station, Hunter River District, New South Wales. Parr has also recorded the species from the Wandagee beds in Western Australia. The Queensland specimens are slightly crushed, but are definitely referable to *A. woolnoughi.* Length of plesiotype, 1.10 mm.; greatest width of coiled portion, 0.54 mm.

Occurrence.—Plesiotype (Comm. Pal. Coll. No. 274): McDougall's Hill, Singleton, Hunter River District, New South Wales (Upper Marine Series). Other Localities.—*Queensland.* Middle Bowen Series: Arcadia Bore, at 2,335-2,340 feet. Lower Bowen Series: Cattle Creek, below Waterfall, 14 miles S.E. of Springsure; Aldbaran Creek, 4 miles N.E. of Mt. Catherine, 30 miles W. of Rolleston.

New South Wales. Upper and Lower Marine Series: localities in the Hunter River District listed by Crespin and Parr (1940).

Genus NODOSARIA Lamarck, 1812.

Nodosaria springsurensis sp. nov. (Pl. III., Fig. 5).

Holotype.—Test elongate, gently tapering, greatest width near apertural end, circular in transverse section. Chambers, six; sutures distinct, depressed. Test covered with about 16 raised longitudinal costae, which extend over the length of the shell. Aperture central, terminal, radiate. Length, 1·62 mm.; greatest width, 0·39 mm.

Observations.—*N. springsurensis* is described from a single well-preserved specimen. The ornamentation is much coarser than in *N. irwinensis* Howchin and slightly coarser than *N. striato-clavata* Spandel which has 20 costae.

Occurrence.—Holotype (Comm. Pal. Coll. No. 275): In Cattle Creek below Waterfall, 14 miles S.E. of Springsure, Queensland (Lower Bowen Series).

Nodosaria serocoldensis sp. nov. (Pl. III., Fig. 6).

Holotype.—Test elongate, smooth, tapering, greatest width in apertural chamber, circular in transverse section. Chambers six, apertural chamber large, others gradually decreasing in size. Sutures indistinct, straight. Aperture small, central, radiate, terminal. Test white. Length, 1.02 mm.; greatest width, 0.43 mm.

Paratype.—Test elongate, longer than holotype. Margins parallel for two-thirds of length then tapering sharply to aboral end. Chambers seven, decreasing in size from apertural end. Sutures indistinct, straight. Aperture central, radiate, terminal. Test brown. Length, 1.21 mm.; greatest width, 0.42 mm.

Observations.—*N. serocoldensis* resembles the Tertiary and Recent species *N. radicula* Linné, in general shape, but differs in the more acute

tapering towards the aboral end and the less impressed sutures. Several specimens of the species are present in the Kulnura Bore, but they are smaller than the Queensland ones.

Occurrence.—Holotype (Comm. Pal. Coll. No. 276) and Paratype (Comm. Pal. Coll. No. 277): Cattle Creek below Waterfall, 14 miles S.E. of Springsure, Queensland (Lower Bowen Series).

Other Localities.—*New South Wales.* Upper Marine Series: Kulnura Bore, at 3,846 feet and 3,884 feet.

Genus DENTALINA D'Orbigny, 1826.

Dentalina grayi sp. nov., (Pl. III., Fig. 8).

Holotype.—Test small, elongate, slender, gently curved and tapering, with greatest width in apertural chamber. Chambers seven, slightly inflated and gradually increasing in size towards apertural end. Sutures distinct, straight, depressed. Aperture terminal, radiate. Length, 0.75 mm.; greatest width, 0.17 mm.

Observations.—*Dentalina grayi* is described from a single well-preserved specimen. It differs from *D. bradyi* Spandel, recorded by Chapman and Howchin from a limestone at Wollong, New South Wales, in its more slender appearance. The species has been named after Dr. K. Washington Gray, who collected the material during his investigations in the Springsure area.

Occurrence.—Holotype (Comm. Pal. Coll. No. 278): Lower part of the exposure on Argus's Selection, Springsure, Queensland (Middle Bowen Series.).

Genus FRONDICULARIA Defrance, 1826.

Frondicularia parri sp. nov., (Pl. III., Figs. 9, 10, 11).

Holotype.—Test elongate, compressed, with greatest width near apertural end; earlier portion tapering sharply, sides of later portion almost parallel. Aboral and subacute. Peripheral margin rounded. Chambers ten. Sutures distinct, marked by clear shell matter, acutely arched along medium line. Wall ornamented with distinct irregular, longitudinal raised costae, extending over whole of test. Aperture small, terminal. Length, 0.80 mm.; greatest width, 0.28 mm.

Paratypes.—(*a*) Test shorter than holotype and tapering more evenly. The costae are irregular and slightly coarser, with a tendency to divide. Chambers distinct. Sutures strongly arched along median line. Length, 0.64 mm.; greatest width, 0.30 mm.

(*b*) Test broad, widest near aperture, and tapering strongly to aboral end. Sutures arched but obscured by surface ornament. Chambers also obscured. Costae coarse with a tendency to anastomose from the median line. Length, 0.77 mm.; greatest width, 0.42 mm.

Observations.—*Frondicularia parri* shows considerable variation in external form, a character which is also marked in *F. woodwardi* Howchin. This variation is illustrated in the figured specimens. The species resembles in costation a form described by Cushman and Waters (1928) as *Spandelina fissicostata.* In both species the costae are irregular and anastomosing, a feature especially noticeable in paratype (*b*). The costae in the holotype are finer than in *S. fissicostata* and the periphery is rounder. The same variation in shape is apparent in both species. *F. parri* is fairly common in the Kulnura Bore, but is rare in the Queensland deposits. The species is named after Mr. W. J. Parr of the Victorian Mines Department.

Occurrence.—Holotype (Comm. Pal. Coll. No. 279) and Paratypes (Comm. Pal. Coll. Nos. 280, 281) : Kulnura Bore, parish Kooree, county Northumberland, New South Wales, at 4,203 feet (Upper Marine Series).

Other Localities.—*Queensland.* Lower Bowen Series: Watershed between Little Gorge and Cabbage Tree Creeks, near Springsure; North bank of Cattle Creek, 14 miles S.E. of Springsure.

New South Wales. Upper Marine Series: Kulnura Bore at 4,020, 4,123, 4,173 and 4,268 feet.

FRONDICULARIA WOODWARDI Howchin, (Pl. III., Figs. 12, 13).

Frondicularia sp. Howchin 1894, p. 336.
Frondicularia woodwardi Howchin 1895, p. 197, pl. x., figs. 4-6; Chapman and Howchin 1905, p. 16, pl. iii., fig. 2.

Observations.—Howchin described this species from the Irwin River, Western Australia. Numerous specimens are present in the Permian deposits of Queensland and New South Wales. The Queensland specimens are well developed. The figured ones are from the Springsure area, and illustrate the variability of the species. Lengths of plesiotypes: (*a*) 1.63 mm.; (*b*) 0.97 mm.

Occurrence.—Plesiotypes (Comm. Pal. Coll. Nos. 282, 283); (*a*) In Cattle Creek below Waterfall, 14 miles S.E. of Springsure, Queensland. (*b*) Mt. Hope, 20 miles S. of Springsure (Lower Bowen Series).

Other Localities.—*Queensland.* Lower Bowen Series: "Eurydesma" beds in "Ironbark" or Little Gorge Creek, near Springsure; Watershed between Little Gorge and Cabbage Tree Creeks, Springsure: 3 miles from Cracow on road to Theodore; 2.5 miles from Mantuan Downs, Springsure road.

New South Wales. Upper Marine Series: Kulnura Bore, at 3,840, 3,865, and 4,203 feet. Lower Marine Series: Hunter River District—Road Cutting, Jackson's Hill, Pokolbin.

Genus GEINITZINA Spandel, 1901.

GEINITZINA TRIANGULARIS Chapman and Howchin (Pl. III., Figs. 14, 15).

Geinitzina triangularis Chapman and Howchin, 1905, p. 16, pl. ii., figs. 9*a*, *b*; 10. Chapman, Howchin and Parr, 1934, p. 181, text figs. 1-5.

Observations.—The specimens of *G. triangularis* figured in this paper are from material from Pokolbin, the type locality for the species, collected by Dr. G. D. Osborne for Oil Search Ltd. They illustrate the megalospheric and microspheric forms of the species. The microspheric form is longer than the megalospheric and the chambers in the early stages are very small and numerous. In another microspheric specimen which is incomplete a terminal spine is present in the earliest portion. All tests are well polished. Length of topotypes: (*a*) 1.01 mm.; (*b*) 0.73 mm.

Occurrence.—Topotypes (Comm. Pal. Coll. Nos. 284, 285): (*a*) microspheric, (*b*) megalospheric—Pokolbin, Hunter River District, New South Wales (Lower Marine Series).

Other Localities.—*Queensland.* Lower Bowen Series: North bank of Cattle Creek, 14 miles S.E. of Springsure; Cattle Creek below Waterfall, near Springsure; Mt. Hope, 20 miles S. of Springsure; 2.5 miles from Mantuan Downs, on Springsure road; 3 miles from Cracow on road to Theodore.

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EXPLANATION OF PLATE III.

Fig. 1.—*Hyperamminoides acicula* Parr. Dry Creek, "Inglelara" property, Springsure, Queensland. Plesiotype, x 30.

Fig. 2.—*Ammodiscus multicinctus* Crespin and Parr. Cattle Creek below Waterfall, near Springsure, Queensland. Plesiotype, x 40.

Fig. 3.—*Calcitornella stephensi* (Howchin). Pokolbin, Hunter River District, New South Wales. Showing surface that has been attached to rock. Plesiotype, x 30.

Fig. 4.—*Ammobaculites woolnoughi* Crespin and Parr. McDougall's Hill, Singleton, New South Wales. Plesiotype, x 30.

Fig. 5.—*Nodosaria springsurensis* sp. nov. Cattle Creek below Waterfall, near Springsure, Queensland. Holotype, x 30.

Fig. 6.—*Nodosaria serocoldensis* sp. nov. Cattle Creek below Waterfall, near Springsure, Queensland. Holotype, x 30.

Fig. 7.—*N. serocoldensis* sp. nov. Locality same as holotype. Paratype, x 30.

Fig. 8.—*Dentalina grayi* sp. nov. Lower part of exposure on Argus's Selection, Springsure, Queensland. Holotype, x 40.

Fig. 9.—*Frondicularia parri* sp. nov. Kulnura Bore, New South Wales, at 4,203 feet. Holotype, x 40.

Fig. 10.—*F. parri* sp. nov. Locality same as holotype. Paratype, x 40.

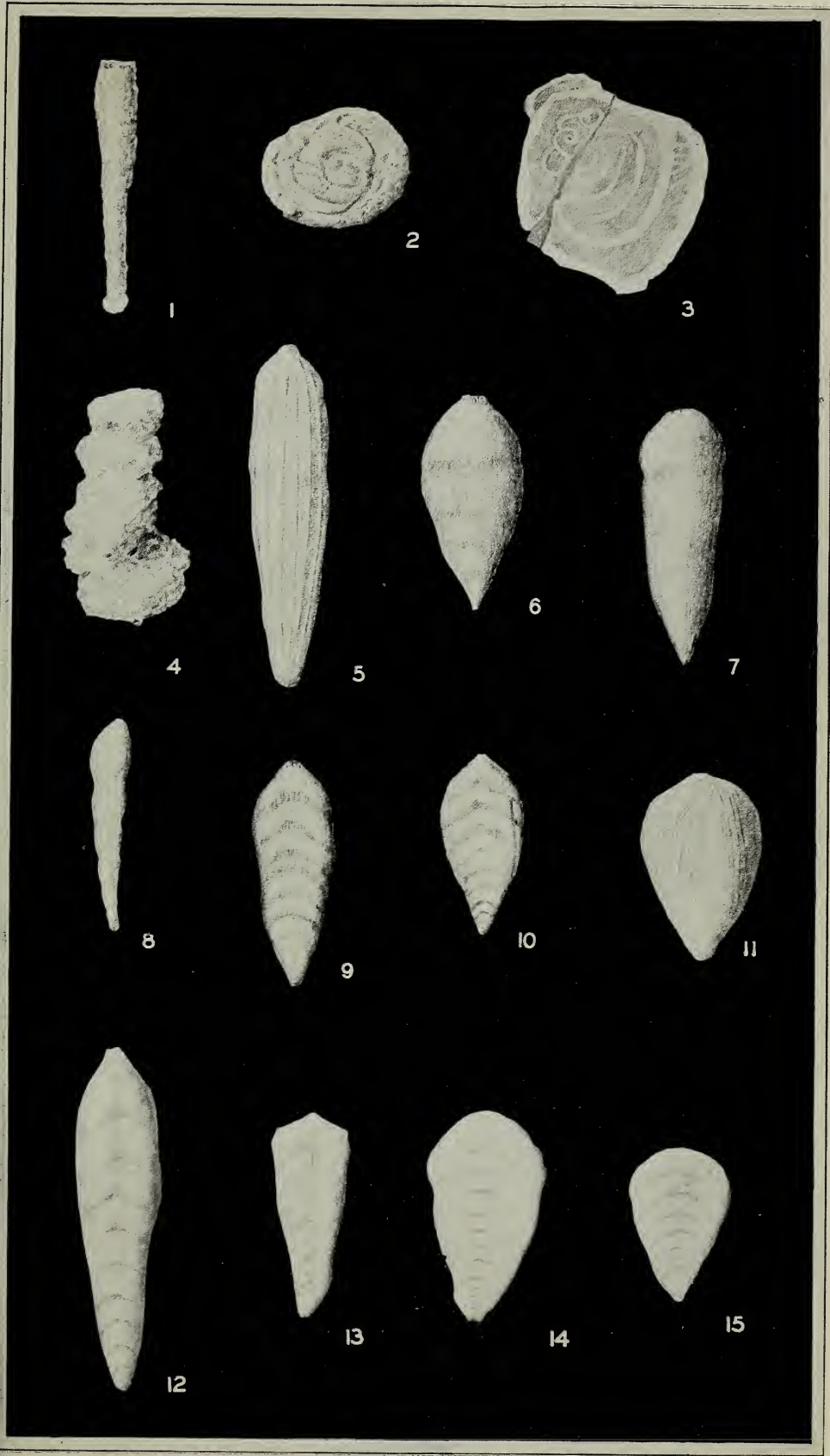
Fig. 11.—*F. parri* sp. nov. Locality same as holotype. Paratype. Showing irregular character of striae, x 40.

Fig. 12.—*F. woodwardi* Howchin. Cattle Creek below Waterfall, near Springsure, Queensland. Plesiotype, x 30.

Fig. 13.—*F. woodwardi* Howchin. Mt. Hope, 20 miles S. of Springsure, Queensland. Plesiotype, x 30.

Fig. 14.—*Geinitzina triangularis* Chapman and Howchin. Pokolbin, New South Wales. Microspheric form. Topotype, x 30.

Fig. 15.—*G. triangularis* Chapman and Howchin. Pokolbin. Megalospheric form. Topotype, x 30.



Permian Foraminifera from Eastern Australia.

PERMIAN OSTRACODA FROM EASTERN AUSTRALIA.

By Irene Crespin, B.A., Commonwealth Palaeontologist, Mineral Resources Survey Branch, Canberra, A.C.T.

(With Plate IV.)

Communicated by O. Jones, M.Sc.

(*Received* 24*th April,* 1944; *read before the Royal Society of Queensland,* 31*st July,* 1944; *issued separately,* 5*th February,* 1945.)

INTRODUCTION.

Only four species of ostracoda have been previously recorded from the Permian rocks of Eastern Australia. Three species were described from New South Wales by Chapman (1920), namely *Leperditia prominens* from Farley and the Caledonian Shaft at Cessnock, at 200 feet, *Primitia dunii* from the Caledonian Shaft and *Jonesina etheridgei* from Farley, and one *Entomia jonesi* by de Koninck (1898) from the Muree Sandstone. The genera *Bairdia, Healdia* and *Cavellina* were recently recognised by the writer in samples of "Fenestella Shale" from an open cut on Barossa road which joins Lenah Valley with Tolossa Street, Glenorchy, Tasmania, but the specimens were too poorly preserved for specific determination. Considerable investigation has been carried out on the ostracoda in America and the well illustrated publications form an excellent basis for comparison with the Australian forms.

The species herein discussed are from the Kulnura Bore, parish Kooree, county Northumberland, and from surface samples from the Hunter River District in New South Wales, and from surface sections in the Springsure area in Queensland. All the ostracoda are associated with a typical foraminiferal assemblage, including *Hyperamminoides acicula* Parr, *Calcitornella stephensi* (Howchin), *Frondicularia woodwardi* Howchin, *F. parri* Crespin and *Geinitzina triangularis* Howchin.

The following new species of ostracoda are described: *Bairdia grayi, Bairdia nyei, Healdia chapmani, Cavellina springsurensis, Cavellina aequivalvis, Cavellina kulnuraensis* and *Basslerella australae.*

All specimens are in the Commonwealth Palaeontological Collection at Canberra. The plate accompanying the paper has been prepared by Mr. F. Canavan, M.Sc., of the Mineral Resources Survey.

DESCRIPTION OF SPECIES.

Genus BAIRDIA McCoy, 1844.

Bairdia grayi sp. nov. (Pl. IV, Figs. 1*a*, *b*.)

Holotype.—Carapace medium sized, short, thick, subtriangular in shape, smooth, valves unequal in size. Dorsal margin strongly arched, ventral outline gently curved. Anterior beak, broad, rounded; posterior beak blunt. Both anterior and posterior beaks slightly above middle height of valve. Hinge line deeply depressed, short. Right valve smaller than left. Overlap of valve is pronounced, especially along dorsal line. Length, 1·67 mm.; height, 1·21 mm.; thickness, 0·76 mm.

Observations.—Bairdia grayi does not resemble any of the described forms from the Pennsylvanian and Permain of America, from which many species of the genus have been figured. Its blunt posterior beak and rounded anterior end, together with the strongly arched dorsal margin, are distinctive characteristics. The species has been named after Dr. K. Washington Gray of the Australasian Petroleum Company, who collected the material during his investigations in the Springsure-Rolleston area in Queensland.

Occurrence.—Holotype (Comm. Pal. Coll. No. 261): Cattle Creek, 14 miles S.E. of Springsure, Queensland, in rich shelly limestone in north bank of Creek (Lower Bowen Series).

Bairdia nyei sp. nov. (Pl. IV, Fig. 2*a*, *b*.)

Holotype.—Carapace medium sized, gently tapering from central portion of dorsal view. Anterior beak, narrow, almost at middle height of valve; posterior beak, low and bluntly acuminate. Dorsal and ventral margins almost straight and parallel in median portion. Post-dorsal margin short, steep; anterior dorsal angulate. Hinge slightly depressed. Muscle scars deeply impressed, arranged in rosette in centre of valve towards ventral margin. Length, 1·3 mm.; height, 0·8 mm.; thickness, 0·75 mm.

Observations.—Bairdia nyei resembles in outline *B. verwiebei* Kellett from the Permian of Kansas, but the posterior beak is shorter and less acuminate in the present form. The carapace is represented by a perfect cast and is stained reddish. The mode of preservation has made the muscle scars prominent. The species has been named after Mr. P. B. Nye, Assistant Director, Mineral Resources Survey.

Occurrence.—Holotype (Comm. Pal. Coll. No. 262): Cranky Corner, Hunter River District, New South Wales (Lower Marine Series); also at Pokolbin in the same district (Lower Marine Stage).

Genus HEALDIA Roundy, 1926.

Healdia chapmani sp. nov. (Pl. IV, Figs. 3*a*, *b*; 4, 5.)

Holotype.—Carapace small, subtriangular, equivalved. Anterior end roundly curved, dorsal margin strongly convex with margin straight towards posterior end. Highest point of curve in middle portion. Posterior end subangulate, ventral margin slightly curved

inwards. Two spines at posterior end, one near dorsal margin and one on ventral margin, both protruding backwards. Surface otherwise smooth. Length, 0·82 mm.; height, 0·54 mm.; thickness, 0·40 mm.

Paratypes.—(*a*) Left valve. Smaller than holotype; posterior end angulate and ventral margin straight. Length, 0·61 mm.; height 0·43 mm. (*b*) Right valve. Shape and size similar to holotype.

Observations.—*Healdia chapmani* is closely comparable with *H. limacoides* Knight, from the Permian of Eastern Missouri. It differs from it in the highest part of the curve on the dorsal margin being central and in the more angulate posterior end. It differs from *H. subangularis* Delo from Western Texas in the shorter length of the carapace. The species has been named after the late Mr. F. Chapman, who described many ostracoda from Australian deposits.

Occurrence.—Holotype (Comm. Pal. Coll. No. 263): Cattle Creek, 14 miles S.E. of Springsure, Queensland, below Waterfall (Lower Bowen Series). Paratypes (Comm. Pal. Coll. Nos. 264, 265): Same locality as holotype. Also in sediments at Mt. Hope near Springsure (Lower Bowen Series).

Genus CAVELLINA Coryell, 1928.

Cavellina springsurensis sp. nov. (Pl. IV, Figs. 6*a, b*.)

Holotype.—Carapace medium sized, ovate. Dorsal surface arched, ventral slightly concave. Posterior thicker than anterior. Surface smooth except for vertical ridge at posterior end of each valve extending to nearly middle distance up dorsal margin. Right valve overlaps left. Anterior end broader than posterior with widest portion just above middle. Length, 1·21 mm.; height, 0·82 mm.; thickness, 0·65 mm.

Observations.—*Cavellina springsurensis* is distinct from any described species. It bears some resemblance to *C. fittsi* Kellett from the Upper Middle Pennsylvanian of Kansas in having a vertical ridge in the posterior portion.

Occurrence.—Holotype (Comm. Pal. Coll. No. 266): Cattle Creek, 14 miles S.E. of Springsure, Queensland, below Waterfall (Lower Bowen Series).

Cavellina aequivalvis sp. nov. (Pl. IV, Figs. 7*a, b*.)

Holotype.—Carapace small, subovate, with rounded anterior and posterior ends, slightly compressed. Valves of equal size and shape, anterior edge broken. Both dorsal and ventral margins parallel. Length, 1·06 mm.; height, 0·62 mm.; thickness, 0·67 mm.

Observations.—This species closely resembles *Cytherella aequalis* Jones, Kirby and Brady (1884, pl. 6, figs. 15*a, b*) described from the Carboniferous limestone of Gare, Lanarkshire, England. The present form is placed in the genus *Cavellina* which was instituted by Coryell in 1928 to include all Carboniferous and Permian species of *Cytherella*. There is no overlap of right valve in *C. aequivalvis* as is typical of the genus.

Occurrence.—Holotype (Comm. Pal. Coll. No. 267) : Kulnura Bore, parish Kooree, county Northumberland, New South Wales, at 3,894 feet, in black carbonaceous shales (Upper Marine Series). Also in Balmain Bore, City of Sydney, at 4,750 (Upper Marine Series).

CAVELLINA KULNURAENSIS sp. nov. (Pl. IV, Fig. 8.)

Holotype.—Carapace medium sized, broad, inequivalved, dorsal margin slightly arched, anterior broadly rounded. Ventral margin slightly convex. Right valve slightly overlapping left at posterior ventral. Greatest width towards anterior dorsal. Height of valves equal in dorsal view, there being variation in thickness from anterior to posterior end. Colour dark brown. Length, 1·69 mm.; height, 0·99 mm.

Observations.—This species is distinguished from *C. lata* Coryell from the Permian of Oklahoma, in the slightly arched shape of the dorsal margin towards the anterior end, the not so apparent overlapping of the right valve over the left, and in the almost uniform thickness of the carapace from anterior to posterior end.

Occurrence.—Holotype (Comm. Pal. Coll. No. 268) : Kulnura Bore, parish Kooree, county Northumberland, New South Wales, at 3,865 feet in black carbonaceous shales (Upper Marine Series). Also at Pokolbin, Hunter River District (Lower Marine Series).

Genus BASSLERELLA Kellett, 1935.

BASSLERELLA AUSTRALAE sp. nov. (Pl. IV, Figs. 9*a*, *b*, 10.)

Holotype.—Carapace large, stout, greatest thickness in central portion, subovate, broader at anterior end. Strong ridges along dorsal and ventral margins. Dorsal margin straight, very depressed, being more pronounced by dorsal ridges. Strong ridge along dorsal edge. Anterior margin slightly angulate with long angle towards ventral edge. Slight overlap of right valve over left at ventral end of angulated anterior portion. Surface smooth. Length, 1·49 mm.; height, 0·97 mm.; thickness, 0·74 mm.

Paratype.—Left valve, showing strong dorsal margin and curved margin of ventral. Carapace broadest near anterior, gently tapering towards posterior, which is slightly pointed. Internal shape of left valve shows relationship with the Cytheridae.

Observations.—This distinctive form is referred to the genus *Basslerella* Kellett, which ranges from the Pennsylvanian to the Permian. Kellett (1935) considers "that members of this genus are the direct ancestors of the *Cytheridea.*" This relationship is well illustrated in Fig. 10 of the present paper. The dorsal and ventral ridges in *B. australae* distinguish it from the described species. Several specimens are present in the Springsure material.

Occurrence.—Holotype (Comm. Pal. Coll. No. 269) : Cattle Creek, 14 miles S.E. of Springsure, Queensland, below waterfall (Lower Bowen Series). Paratype (Comm. Pal. Coll. No. 270) : Same locality.

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EXPLANATION OF PLATE IV.

Fig. 1.—*Bairdia grayi* sp. nov. Cattle Creek, 14 miles E. of Springsure, Queensland. Holotype. (*a*) Right side of carapace; (*b*) dorsal view.

Fig. 2.—*Bairdia nyei* sp. nov. Cranky Corner, Hunter River District, New South Wales. Holotype. (*a*) Right side of carapace; (*b*) dorsal view.

Fig. 3.—*Healdia chapmani* sp. nov. Cattle Creek, 14 miles S.E. of Springsure, Queensland. Holotype. (*a*) Right side of carapace; (*b*) dorsal view.

Fig. 4.—*H. chapmani* sp. nov. Same locality as Holotype. Paratype. Right valve.

Fig. 5.—*H. chapmani* sp. nov. Same locality. Paratype. Left valve.

Fig. 6.—*Cavellina springsurensis* sp. nov. Cattle Creek, 14 miles E. of Springsure, Queensland, below Waterfall. Holotype. (*a*) Left side of carapace; (*b*) dorsal view.

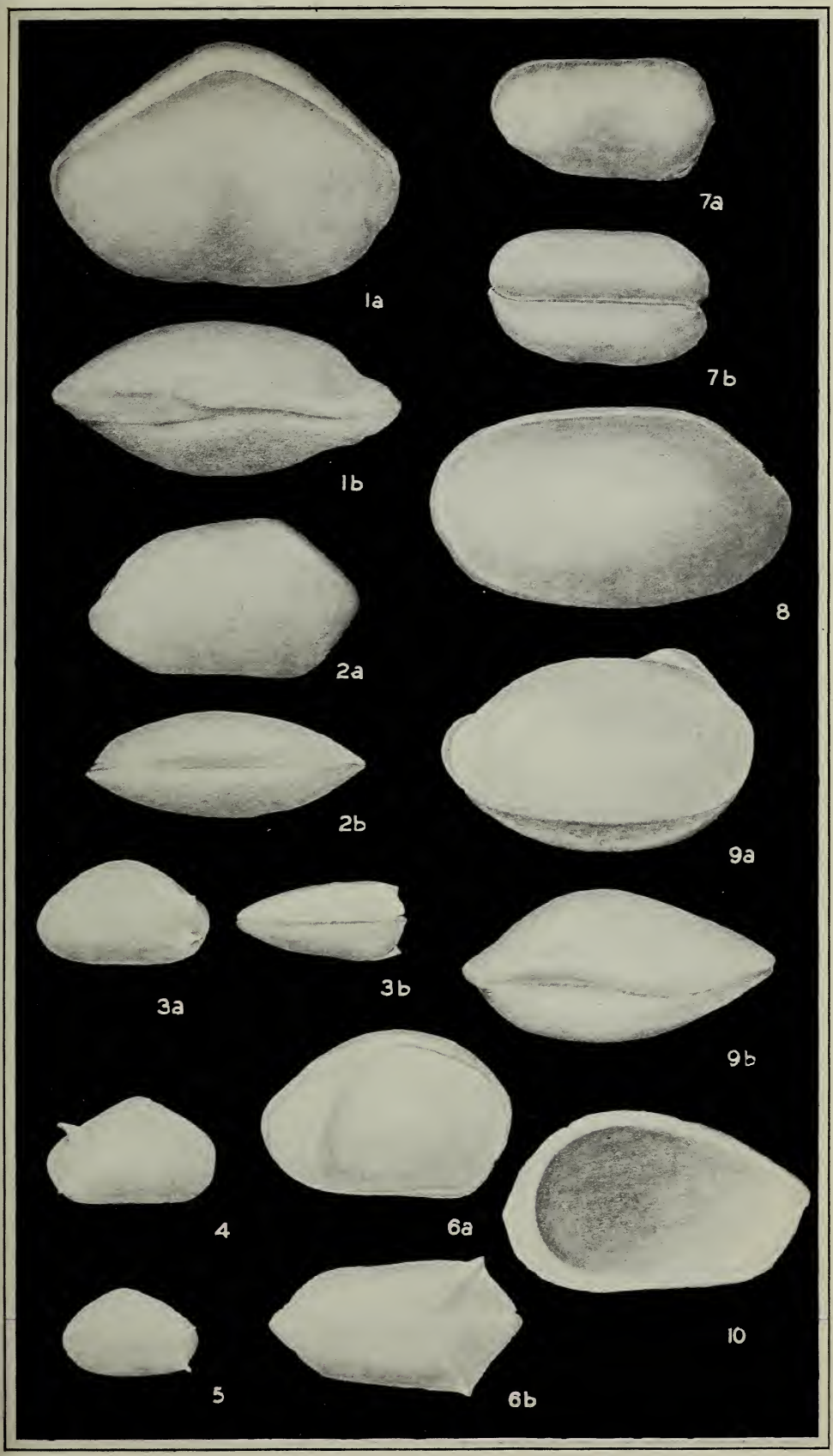
Fig. 7.—*Cavellina aequivalvis* sp. nov. Kulnura Bore, parish Kooree, county Northumberland, New South Wales at 3,894 feet. Holotype. (*a*) Right side of carapace; (*b*) dorsal view.

Fig. 8.—*Cavellina kulnuraensis* sp. nov. Kulnura Bore, New South Wales, at 3,865 feet. Holotype. Right side of carapace.

Fig. 9.—*Basslerella australae* sp. nov. Cattle Creek, 14 miles S.E. of Springsure, Queensland, near Waterfall. Holotype. (*a*) Right side of carapace; (*b*) dorsal view.

Fig. 10.—*B. australae* sp. nov. Same locality as Holotype. Paratype. Internal left valve.

All Figures × 30.



Permian Ostracoda from Eastern Australia.

TRIASSIC INSECTS OF QUEENSLAND.

1. Eoses, a Probable Lepidopterous Insect from the Triassic Beds of Mt. Crosby, Queensland.

By Norman B. Tindale, B.Sc., South Australian Museum.

(With Three Text-figures and One Plate.)

(*Communicated by T. D. Dimmick.*)

(*Received 24th April,* 1944*; read before the Royal Society of Queensland,* 31*st July,* 1944; *issued separately* 27*th April,* 1945.)

Rich fossil insect material has been discovered in a horizon in the Triassic beds of Mt. Crosby, Queensland. In the course of a preliminary study of some of the orders of insects represented, a privilege made possible through the courtesy of the University of Queensland and the kindness of Professor H. C. Richards of the Department of Geology, Mr. F. A. Perkins, Lecturer in Entomology, and Messrs. W. R. Horne and I. F. B. Common, much of special interest has been observed among fossil insects related to the Mecopteroid or Panorpoid stem. The following description is a first contribution to the study of the Mecopteroid insects of these beds. It may prove to be of special interest to those studying the origin of the Order Lepidoptera.

The Mt. Crosby fossil insect horizon is situated near the Brisbane River, five miles to the north of Ipswich. The horizon was first discovered by Jones and Denmead in 1925 on Portion 172, Parish of Chuwar. From this outcrop (Locality A) insect wings were collected and exhibited before the Royal Society of Queensland (Jones, 1926). The stratigraphical horizon of these was indicated by Jones (1927) in an appendix to a paper on the Tertiary Deposits of the Moreton District. The insects were later described by Tillyard (1937) as two new species of the genus *Triassoblatta.*

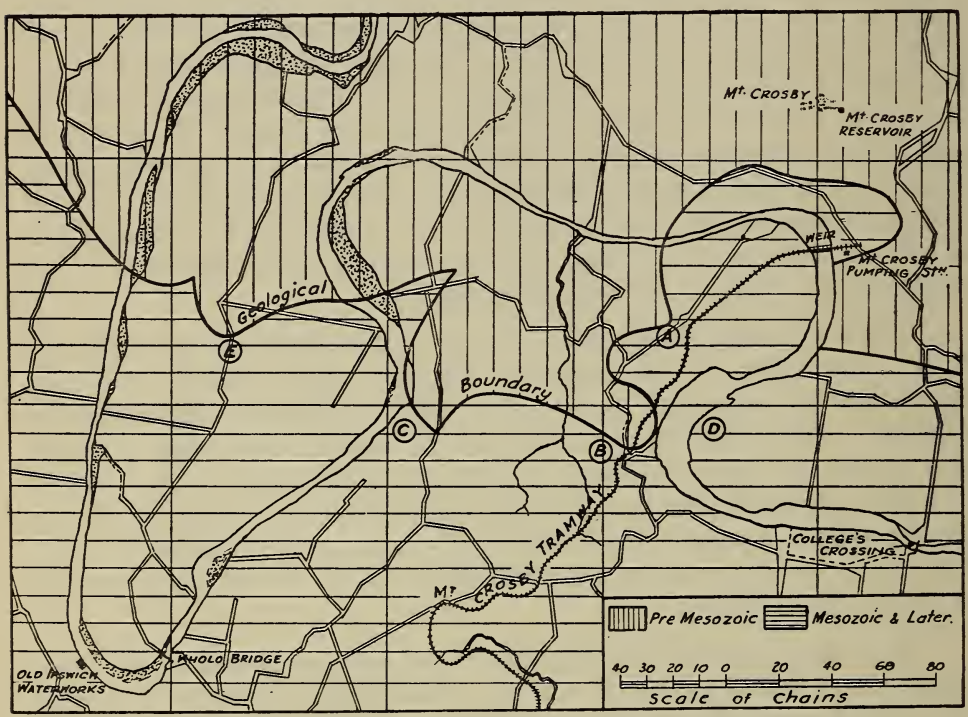
At a later date further localities in the same area and on the same horizon were found by Mr. H. Cribb*, one of which (Locality B) is that from which the insects forming the subject of this paper were obtained (Text-figure 1). The localities discovered to date (including the above may be listed as follows:—

Localities Supplied by H. Cribb.

A. Portion 172, Parish of Chuwar. Found by Jones and Denmead.
B. Portion 202, Parish of Chuwar. Found by H. Cribb.
C. Portion 171, Parish of Chuwar. Found by H. Cribb.
D. Portion 22-23, Parish of Kholo. Found by H. Cribb.
E. Portion 10-11, Parish of Kholo. Found by H. Cribb.

* Verbal communication from Dr. W. H. Bryan.

The site of Locality B is in a railway cutting on a branch railway line leading from Ipswich to the Mt. Crosby Pumping Station. Here a basal conglomerate containing quartzite boulders and pebbles unconformably overlies the Fernvale Series of the Brisbane Schists, dips at a low angle to the S.W. and is overlain by shales. It is thus within a short distance of the base of the Ipswich Series of Upper Triassic age. The fossil horizon is a band in these shales situated approximately 20 feet above the top of the conglomerate and occurring at intervals over a distance of more than two miles. Collectors who visit Locality B may locate the horizon by counting 144 railway sleepers from the near side of the road bridge which spans the railway cutting. The insect-bearing horizon will then be found as a band in the S.W. wall of the cutting approximately 3 feet above the level of the rails. The fossils are not confined to one layer but have been proved to occur at various levels in a band at least a foot in thickness. No systematic study has been

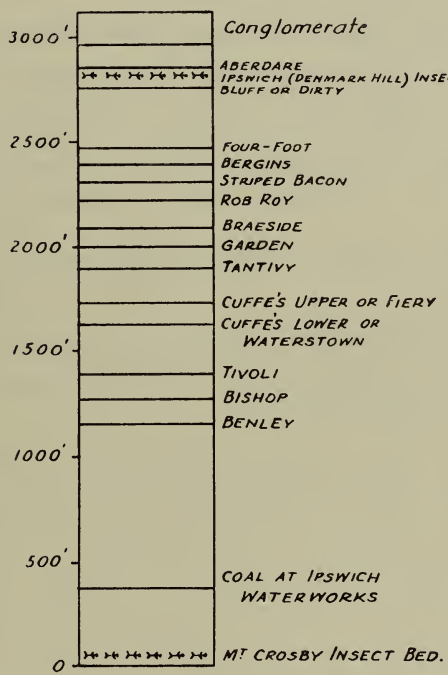


Map showing Fossil Insect Localities (A) to (E) Mt. Crosby Area.

Text Fig. 1.

made of the minute stratification of the occurrence. Specimens are relatively abundant in the fossiliferous horizon, the average rate of discovery being about two good specimens per hour of splitting of the soft shale. Several thousand specimens have been secured by different collectors from the several occurrences on this horizon. Impressions of wings of Coleoptera and Orthoptera seem to predominate but wings of many Homoptera as well as some Mecoptera, Trichoptera, and kindred insects occur.

The Mt. Crosby insect horizon occurs nearly at the base of the Ipswich series (Text-figure 2). The age of this series has been determined on palaeobotanical grounds as Upper Triassic (Rhaetic or Keuper ?). A rapid survey of the whole insect fauna from Mt. Crosby has given a strong general impression that its horizon is lower than that of the insect horizon at Denmark Hill. This is in keeping with the field evidence which places the Denmark Hill horizon as nearly at the top of the Ipswich Series. This higher insect horizon has been known for many years, and has been the subject of detailed geological and faunistic studies by Tillyard and Dunstan, but the more recently discovered Mt. Crosby horizon has yet to be adequately studied. This paper is only a preliminary account of one of the many interesting forms which the fauna contains.



TEXT FIG. 2.

Stratigraphical Section of Ipswich Coal Measures to show the positions of the two known insect horizons. (Modified from Cameron.)

Family EOSETIDAE nov.

Genus EOSES.

Eoses triassica gen. et sp. nov. (Plate V).

Forewing broad, costal margin straight in basal half, then evenly curved to a rounded point at R_4; hind margin rather evenly rounded. Costa with hm vein present, Sc_1 and Sc_2 present. Traces of a possible oblique cross-vein between Sc and R_1. R_1 from R_s in basal third of wing. Second radial fork at one-half; R_2 and R_3 long-forked; R_4 from R_5

just before median cross-vein; a cross-vein between R_3 and R_4. Median fork (mf) near base; mf_1 before one half, simple; M_2 bifurcate; an im cross-vein present between M_2 and M_3. M_4 forming a reverse fork with Cu_{1a} but dividing again and M_4 free at margin. M_5 present as a short vein to Cu. Region of cubital fork (cuf) not available in type; Cu_{1a} joining M_4; Cu_{1b} continuing straight to margin; Cu_2 present. Pcu a strong vein; region of anal (vannal) veins not preserved. Length of available portion of forewing 11 mm. Fig. 1.

Hindwing similar to forewing but with costa more angulate and apex situated slightly posterior to R_5. Veins much as in forewing except that there are no apparent traces of the possible cross-vein between Sc and R_1; R_4 is from R_5 well before r-m cross-vein. Length of preserved portion of hindwing 9 mm. Fig. 2.

Holotype, the counterpart of an impression of a forewing labelled "Mt. Crosby No. 218" in University of Queensland Collection: (Catalogue No. F. 7853); belonging to this is a fragment of the obverse impression, labelled "218 a" in University of Queensland Collection (F. 7854); paratype, a hindwing labelled "207" in University of Queensland Collection (F. 7855); for this no counterpart was recovered.

Locality: Triassic of Mt. Crosby, S. Queensland. Collected by F. A. Perkins.

The hindwing resembles the forewing in a similar manner and to about the same degree as does the fore and hindwing in any primitive Mecopteroid insect of comparable size.

The formal description of the species is to be regarded as based on the type forewing. The hindwing which has been associated with it, as a paratype, was found separately; therefore there is no direct proof that it actually belongs to the same species. However the two specimens are so closely comparable that in any living species of primitive Lepidoptera, for example, it would be difficult not to regard them as fore and hindwing of one species, or at least as belonging to closely allied members of the same genus.

R_1 near apex is sinuate as though there was a pterostigmatic area on the costal margin at its apex, but no special texture of the wing surface can be detected in this region, so that this feature must be regarded at most as indicating what might be a relict feature.

Theoretical Discussion.

The position of this fossil in the classification of insects may be of considerable theoretical importance, since it seems possible that it is one of the earliest known relatives of the Lepidoptera, an order concerning whose early geological history in Mesozoic times, nothing is known. Its discovery will therefore arouse new interest in the possible origins of the Lepidoptera.

On general grounds it has long been considered that the members of the suborder Homoneura are the oldest living types of Lepidoptera and that some living species retain primitive features which place them close to the prototype of that order of insects. Indeed, from a study of all the living forms a hypothetical archetype of the order has been conceived as appearing very much like some primitive living members of the Hepialidae, one of the largest families of the Homoneura. However, up till now no true member of the Lepidoptera has been discovered in any geological horizon lower than the Tertiary.

The hitherto oldest known fossils which are without doubt Homoneurous Lepidoptera, belong to the family Micropterygidae, the oldest actual species being *Micropteryx proavitella* Rebel which was obtained from Baltic amber of Oligocene Age. Another similar species *Micropteryx pervetus* Cockerell has been found; in Miocene amber from Burma. *M. proavitella* differs only in minor generic details from living members of its family and furnishes no novel clues as to the origins of the Lepidoptera. Further it was found in association with more specialised forms closely related to living genera and species of advanced families of Lepidoptera. It is evident that the origins of the Lepidoptera must be sought in earlier geological ages.

Some poorly preserved insect impressions from the Jurassic were formerly thought, by Handlirsch, to have belonged to the Lepidoptera but were afterwards proved to be unquestionably the remains of Homoptera allied to some primitive living forms of cicada, so that although a possible Jurassic origin for the Lepidoptera was formerly postulated it had no basis in known facts. There was only indirect deduction upon which to base any assumption that the Lepidoptera was Mesozoic in origin, although on general grounds it was thought that their evolution must have taken place concurrently with the rise of flowering plants in Mesozoic times. However, as we know from the previous work of many students, including Handlirsch, Tillyard, Carpenter and other workers, that all the other principal stems of the Mecopteroid complex of orders were already well defined by early Mesozoic times, the appearance of a primitive member of the Lepidoptera in late Triassic beds would neither be a matter of great surprise nor greatly inconsistent with modern trends of knowledge and theory. In fact the entire absence of the Lepidoptera from the Mesozoic period would be surprising on any grounds, other than that of the difficulty of finding the rare beds in which such delicate insects could be preserved.

The question naturally arises whether, in view of the trend of this introduction, *Eoses* is possibly to be regarded as a primitive Lepidopteron? Accepting for the moment that the fore and hind wings do belong together, it is abundantly clear that if these wings were those of Lepidoptera the species would fall much closer to the suborder Homoneura than to the Heteroneura, the other large division of the order Lepidoptera. The most striking distinction between these two great suborders is the possession by the Homoneura of five radial veins in

both wings whereas in Heteroneura although 5 radial veins are present in the fore wing, only two occur in the hind wing. Of the families of the Homoneura, so far as may be judged by wing venation alone, *Eoses* would fall perhaps closer to the Hepialidae than to any other. In many particulars it is closely similar. However, one striking character at once separates *Eoses* from all previously known families of the Homoneura and indeed from all living Lepidoptera. This outstanding feature is present in the median veins of both wings. Whereas in all living Lepidoptera M_2 is a simple vein, in *Eoses* M_2 is bifurcate. In any discussion therefore on this fossil, the study of M_2 is of prime importance. Another important character is the separation of M_4 and Cu_{1a} before the margin. This also is a distinctive feature, but in as much as this has been found as an occasional aberration in individual specimens of more than one species of the Hepialidae, e.g., *Trictena argentata* and *Sthenopis,* its presence in a supposed ancestral form of the Hepialidae would not be a surprising occurrence.

In other venational particulars, so far as they are preserved in the examples available, there can be no strong objection to *Eoses* being placed as a member of the Lepidoptera or even in a position on the ancestral line leading to the Homoneura and the family Hepialidae.

The seemingly critical character upon which the classification of *Eoses* should rest is shown to be the presence of both M_{2a} and M_{2b}, a double feature found in none of the living forms of Lepidoptera.

Study of late Palaeozoic members of the Mecopteroid complex shows that M_2 is bifurcate in several forms. *Permochorista,* a genus of the order Mecoptera of the Upper Permian of Belmont has this feature well defined, and it survives in Jurassic members of the order.

According to the views of Tillyard, the Upper Permian genus *Belmontia* placed in the order Paramecoptera is the oldest recognisable form related to the ancestor of the Lepidoptera. The Paramecoptera are a Permian derivative of the Mecoptera and alongside many primitive features have developed some specialised characters. Tillyard considered that the three great orders Trichoptera, Lepidoptera and Diptera arose from the Paramecoptera in the Triassic or Lias.

While *Belmontia* does present many primitive features it cannot be considered directly ancestral to *Eoses,* for M_2 is already simple in *Belmontia.* The common ancestor of *Eoses* and *Belmontia* must be sought rather in those members of the Permian Mecoptera in which this vein had not already undergone reduction to the simple condition. *Eoses* thus possesses an archaic venational character which separates it definitely from *Belmontia* and links it with the Permian members of the order Mecoptera. The possible conclusion is reached that *Eoses* may be a Triassic development of and lineally descended from one of the Permian branches of the Mecoptera. It is probably not directly related to

Belmontia, although this fossil stands on a side branch not very far removed from the main stem. It seems then that the discovery of *Eoses* again draws attention to the fundamental relationship between the ancestral Mecoptera and the Trichoptera and Lepidoptera, a relationship which tended to be overlooked after the discovery of *Belmontia.*

Detailed comparisons between *Permochorista* and *Eoses* indeed show that however much the form of the wings and the general appearance may differ, there are basic features in common extending even to the possible relict character of a pterostigmatic area on the costal margin, and it seems an irresistible conclusion that *Eoses* and *Permochorista* are fundamentally related, and that this relationship exists because they had common ancestors in Permian times.

The tentative conclusion is reached therefore that *Eoses* is a primitive Lepidopteron, representing a stock which had its origin in a branch of the order Mecoptera, from which it parted company at the end of the Palaeozoic or in the early Mesozoic.

Having been so bold as to see in *Eoses* an early member of the Lepidoptera and therefore the first known Mesozoic member of the order, the writer is tempted to determine a tentative classification into which it may be placed.

Eoses may be conceived to be related to, and to fall in the same suborder as, the ancestor of both the Homoneura and the Heteroneura. As both Comstock and Tillyard have shown, any attempt to construct an archetype for the Heteroneura leads inevitably to an ancestral Homoneurous type, and this archetype, as deduced even in the absence of any leads from fossil evidence, differed significantly from *Eoses* principally in the character of the bifurcate M_2.

For convenience it may be useful to regard this archetypic concept in so far as it is represented by *Eoses* as constituting a suborder Eoneura of the Lepidoptera, equal in classificatory value with the Homoneura and the Heteroneura. Both the Homoneura and Heteroneura may have been formerly derived from the Eoneura. This new classificatory concept must be viewed in very broad detail, and it is as well to remember that *Eoses* itself may not be a direct lineal ancestor of the later Lepidoptera, rather but one representative of a whole range of early Lepidoptera of the Eoneura, from one of which later Lepidoptera may have been derived by reduction and specialisation of the characters which we see in the Eoneura. In so far as both Homoneura and Heteroneura differ from the Eoneura in the absence of the bifurcate M_2 it may be that they are both to be derived together from a member of the Eoneura in which this reduction had already taken place.

A tentative classification could be arranged as follows:—

Order Lepidoptera.

1. Suborder Eoneura.

(*a*) Family Eosetidae.

2. Suborder Homoneura.

   (*a*) Family Micropterygidae.

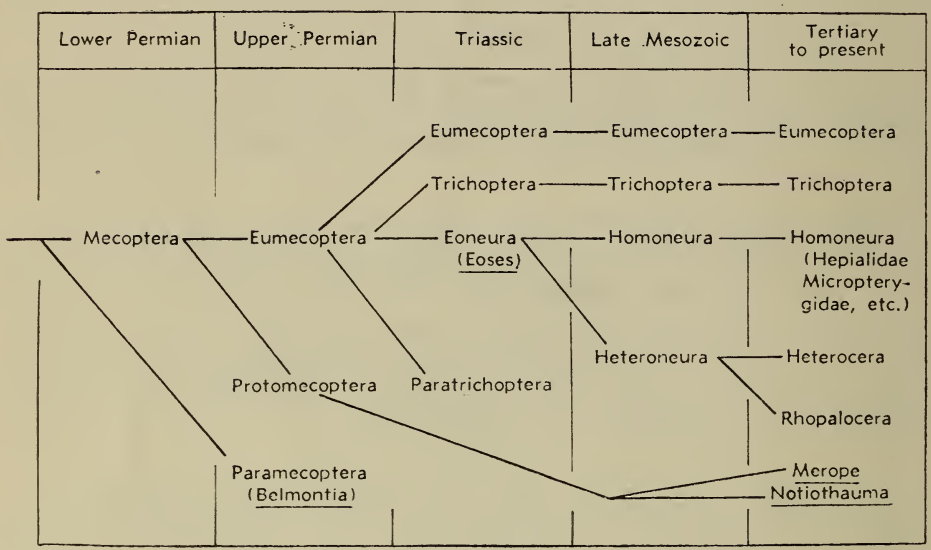
   (*b*) Family Hepialidae.

3. Suborder Heteroneura.

   (*a*) Family Cossidae.

   (*b*) Family Castniidae, etc.

The interrelations of these suborders and the ancestral connections of the Lepidoptera cannot of course be shown adequately by a mere list and the following diagram may give a more convincing if still very sketchy conception of the main relationships:



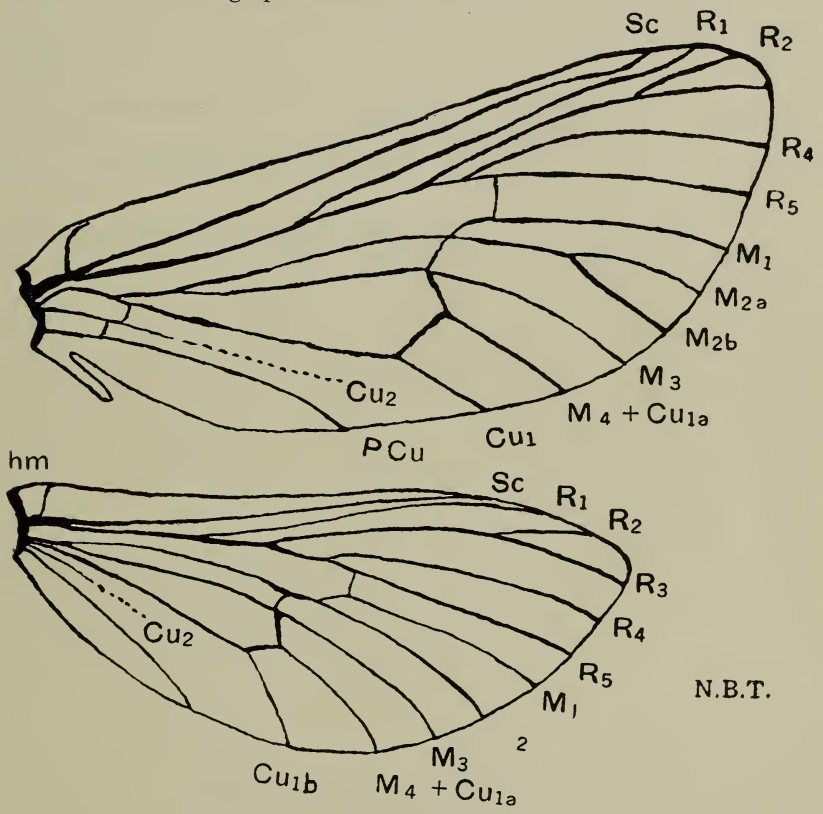
Belmontia preserves a record of one of the evolutionary trends of Mecopteroid ancestors in late Palaeozoic times, but it is seemingly merely a Permian specialisation away from the main Mecopteroid stem. It thus loses its high place as a supposedly direct ancestor to the Lepidoptera and Trichoptera and falls into an evolutionary backwater without recognised descendants in the Mesozoic. Like the Trichoptera, the Lepidoptera seem to have originated as closely allied specialisations from an ancestral Permian branch of the Mecoptera. *Eoses* preserves a Triassic phase of this evolution. The trends of development even in the Lepidoptera Eoneura were towards reduction of the cross-vein systems, reduction of terminal branching of the veins and partial coalescing of the apical portions of Cu_{1a} and M_4. This trend towards reduction has continued until Tertiary times. All the main evolutionary trends in venation are expressed in modern families by various degrees of simplification and reduction from the ancestral Eoneurous pattern.

SUMMARY.

Eoses triassica a member of the order Lepidoptera, falling into a new suborder, the Eoneura is described from the Triassic Beds of Mt. Crosby, South Queensland. There is a theoretical discussion on the significance of this discovery of the first supposed Mesozoic member of the Lepidoptera.

Postscript: *Washington, D.C.*, 10*th October*, 1944.

In the United States National Museum collection there is a male specimen of *Hepialus sequoiolus* Behrens, from Mendocino, California, which has both M_{2a} and M_{2b} present in the forewings, as in the fossil *Eoses*.. Right and left forewings both have this feature which, so far as known, is unique among living Lepidoptera. The hindwings are normal. Text-fig. 3 gives a representation of the venation of this interesting specimen.



Text Fig. 3.

Venation of aberrant male of *Hepialus sequoiolus* Behrens, from Mendocino, California.

No other specimen of this species among ten others in the collection has been discovered to possess this aberrant condition, nevertheless the appearance of a bifurcate M_2, even as an occasional atavistic survival in a living member of the Hepalidae, may be considered to furnish some small measure of proof that the ancestor of the Lepidoptera Honroneura may once have possessed this character as a normal feature of its venation.

The discovery may be held to strengthen a little the view that *Eoses* is an early Lepidopteron allied to the main stem from which the Homoneura have evolved.

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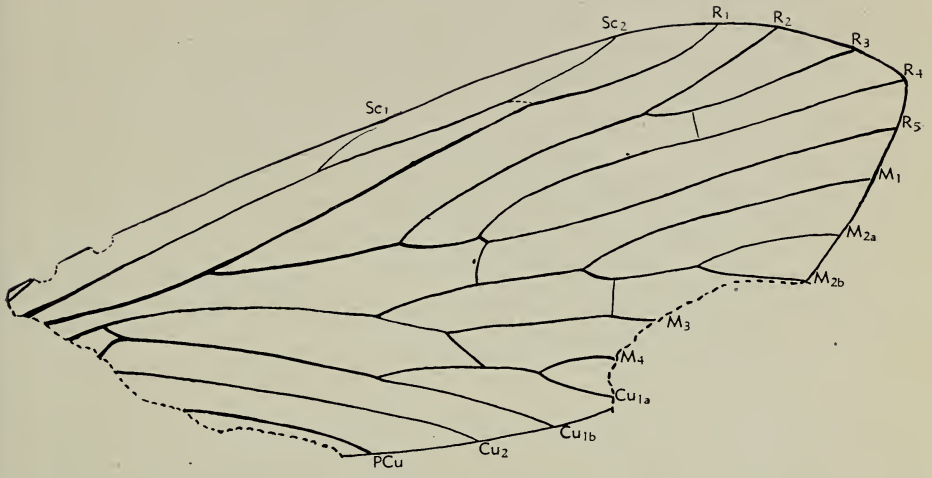

Fig. 1.

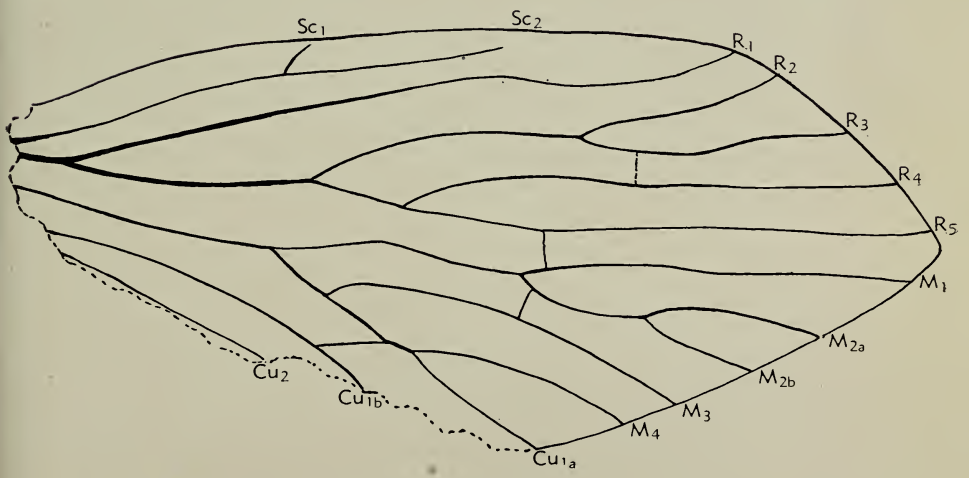

Fig. 2.

Eoses, a probable Lepidopterous Insect. Explanation in the text.

A REVISION OF THE AUSTRALIAN COSSIDAE (LEPIDOPTERA).

By A. Jefferis Turner, M.D., F.R.E.S.

(*Received* 26*th June,* 1944; *accepted for publication* 31*st July,* 1944; *issued separately* 19*th June,* 1945.)

DEFINITION.

Tongue and maxillary palpi absent. Usually an areole is present in the forewing and a median cell in both wings, but there are some exceptions. The median vein is present in the lepidopterous cell, and usually divides there into its two primary branches, but one of these may be absent. The second cubital vein is present in both wings. The anal vein in the forewing is forked at its base. In the hindwing there are three anal veins. The larvae are wood-borers.

The Cossidae, as is shown by their neuration, are the most primitive family of the Lepidoptera Heteroneura. In the Transactions of the Entomological Society of London for 1918 I gave a general review of the family based on the world-fauna, and to this I would refer the reader who is interested in its phylogeny. The family is present in all temperate and tropical regions, but is more numerous in species in Australia than in any other continent. For these two reasons their study is of special interest.

Owing to their cryptic coloration and habit of concealment little was known of our Australian species until recently. Only a few were named by early writers. It was not until the study of the habits and the breeding of the larvae were undertaken, that adequate material for description was available. For this we are indebted particularly to two collectors, the late Mr. F. P. Dodd and the late Mr. W. B. Barnard. An interesting account of the methods of the former is contained in Oberthur's Études de Lepidopterologie Comparée xi. (1915). All the Australian species and, with the exception of *Xyleutes, Zeuzera* and *Dudgeonea,* all the genera are endemic.

Key to Genera.

1.	Forewings without areole	*Idioses* 8
	Forewings with areole	2
2.	Tibiae with spurs very short or absent	3
	Tibiae with spurs well developed	9
3.	Areole with strong posterior projection	4
	Areole not projecting	8
4.	Hindwings with subcostal not connected with cell ..	5
	Hindwings with subcostal connected with cell ..	7
5.	Forewings without median cell	*Sympycnodes* 1
	Forewings with median cell	6
6.	Thorax and abdomen smooth	*Catoxophylla* 2
	Thorax and abdomen hairy	.. *Xyleutes* 3
7.	Hindwings with subcostal connected by a bar with upper angle of cell	*Zeuzera* 4
	Hindwings with 11 arising from before end of cell and running into subcostal	*Nepiomorpha* 5

8. Forewings with areole and median cell short; abdomen not hairy .. .. *Brachycyttara* 6
Areole and median cell long; abdomen hairy .. .. *Ptilomacra* 7

9. Forewings without median cell .. .. *Charmoses* 9
Forewings with median cell 10

10. Forewings with 11 from cell 11
Forewings with 11 from areole 14

11. Forewings with 8 absent .. .. *Trigonocyttara* 10
Forewings with 8 present 12

12. Forewings with 7 and 8 connate or stalked 13
Forewings with 7 and 8 separate .. .. *Cossodes* 11

13. Thorax smooth .. .. *Dudgeonea* 12
Thorax with rough posterior crest .. .. *Archaeoses* 13

14. Forewings with 8 and 9 stalked .. .. *Culama* 14
Forewings with all veins separate .. .. .. *Macrocyttara* 15

1. Gen. SYMPYCNODES Turn.

Trans. Roy. Soc. S.A. 1932, p.194.

Palpi very short, slender, closely appressed to face. Antennae of male bipectinate, apical third simple. Thorax with a rounded anterior crest. Forewings with no median cell, areole long with a strong posterior projection, 7 and 8 stalked, 9 connate, 11 from cell shortly before areole. Hindwings with small median cell, or none owing to posterior branch of median failing to chitinise, all veins separate. Type *S. trigonocosma* Turn.

1. Sympycnodes trigonocosma Turn.

Trans. Roy. Soc. S.A. 1932, p.194.

North Queensland: Cape York. Queensland: Brisbane; McPherson Rge.; Toowoomba; Bunya Mts.

This species appears to be close to *Xyleutes minima* Houlbert from New Guinea (Oberthur, Lep. Comp. xi. p. Pl. p. 80. f. 15).

2. Sympycnodes rhaptodes Turn.

Proc. Roy. Soc. Q. 1941, p.80.

Queensland: McPherson Rge.; Stanthorpe. New South Wales: Nambucca Hds.; Mittagong.

2. Gen. CATOXOPHYLLA nov.

κατοξοφυλλος, with sharply pointed wings.

Palpi moderately long (1), smooth, appressed to face; terminal joint minute. Antennae of male bipectinate, extreme apex simple. Thorax and abdomen smooth-scaled. Tibiae without spurs. Forewings narrow, sharply pointed, areole strongly projecting, median cell long and narrow, 7 and 8 stalked, 9 connate, 11 from near base of areole. Hindwings moderately broad at base, rapidly narrowing to apex, a triangular median cell, all veins separate. Differs from *Xyleutes* in the narrow wings and smooth thorax and abdomen.

3. Catoxophylla cyanauges n.sp.

κυανανγης, with dark blue sheen.

♂, 80-90 mm. Head and thorax dark fuscous with dark blue sheen; thorax with collar, lateral aspect, and inner edge of tegulae white. Palpi dark fuscous, beneath white. Antennae blackish; pectinations in male 8. Abdomen blackish; on posterior half edges of segments and a median line white. Legs dark fuscous. Forewings very narrow, costa straight, sinuate beyond middle, apex acute; fuscous with coarse transverse blackish strigulae arranged in longitudinal rows between veins; some small white dots in apical and terminal areas. Hindwings with termen strongly concave, apex very acute; dark fuscous becoming blackish in basal and tornal areas; a white costal streak to three-fourths; cilia white.

West Australia: Toodyay in August; Bencubbin; two specimens.

3. Gen. XYLEUTES Hb.

Verz. p.195.

Palpi short or moderate, slender, closely appressed to face. Antennae of male bipectinate, becoming simple near middle. Thorax and abdomen hairy. Tibiae without spurs. Forewings with areole long and projecting strongly posteriorly, 7 and 8 stalked, 9 connate or stalked with them, 11 from areole near its base, median cell present. Hindwings with median cell, all veins separate. Type *X. strix* Cram. from Archipelago and India.

This large genus is found in the Indomalayan, African, and Neotropical regions, but the species are more numerous in Australia than elsewhere. Their discrimination is difficult, for they often show varietal differences, especially in the development of the markings of the forewings. Sexual differences are not uncommon, and the range of size in any species may be large. For their identification careful and detailed descriptions are necessary, and these must be carefully studied. No help would be given by the construction of a key, such as is useful in many other cases.

4. Xyleutes zophospila n.sp.

ζοφοσπιλος, dark-spotted.

Head white with an ochreous line between antennae. Palpi one-half; fuscous, lower surface white. Antennae white; pectinations in male 5, dark fuscous. Thorax white with two pairs of blackish dots; small anterior and posterior crests and posterior edge of patagia ochreous. Abdomen white; blackish rings with ochreous apices on five terminal segments; tuft ochreous. Forewings narrow, costa slightly arched, apex obtusely pointed, termen rounded, oblique; white with numerous blackish spots; a costal series more or less transversely elongate; a similar dorsal series; others irregularly dispersed in disc; three obliquely transverse series in lines at three-fourths, subterminal and submarginal; a terminal series; cilia white. Hindwings white with some blackish spots in apical area only; cilia white. It differs from the two following species in the white hindwings.

West Australia: Edmond Station near Carnarvon in June (J. C. Carmody); one specimen. Type in Queensland Museum.

5. Xyleutes riparia Turn.

Proc. Roy. Soc. Q. 1935, p.49.

I have now examined a long series of this species, and my former description needs amplifying. The antennal stalk is white in the male and usually in the female also. The thorax has anterior and posterior lines of hairs, which may be orange-ochreous, fuscous-grey, or ochreous-grey. Similarly the abdominal tuft varies in colour. The white markings of forewings vary considerably in shape and size.

Queensland: Injune; Carnarvon Rge.; Stanthorpe. New South Wales: Tyringham.

6. Xyleutes tigrina H-Sch.

Ausser. Schmet. f.41; Wlk. vii, p.1541.

Judging from Herrich-Schaefer's figure this seems distinct from *X.riparia,* though nearly allied.

Australia.

7. Xyleutes neuroxantha Low.

Proc. Linn. Soc. N.S.W. 1900, p.39.

Unknown to me.

New South Wales: Broken Hill.

8. Xyleutes eumitra Turn.

Trans. Roy. Soc. S.A. 1926, p.154.

Queensland: Brisbane; McPherson Rge.; Toowoomba; Bunya Mts.

9. Xyleutes eremonoma Turn.

Trans. Roy. Soc. S.A. 1906, p.139.

Queensland: Goondiwindi; Cunnamulla.

10. Xyleutes amphiplecta Turn.

Trans. Roy. Soc. S.A. 1932, p.195.

Queensland: Dalby; Milmerran; Injune; Charleville; Inglewood; Goondiwindi; Talwood; Cunnamulla. New South Wales: Brewarrina. Victoria: Birchip.

11. Xyleutes spilota Turn.

Proc. Roy. Soc. Q. 1935, p.49.

Queensland: Toowoomba. New South Wales: Brewarrina.

12. Xyleutes plocistis n.sp.

πλοκιστις, woven.

♂, 34-44 mm. Head whitish. Palpi very short; black. Antennae black; in male bipectinate to three-fifths or two-thirds, pectinations 3. Thorax dark fuscous; patagia and tegulae whitish. Abdomen whitish; apices of segments and tuft black. Legs black. Forewings elongate-oval, costa scarcely arched, apex rounded, termen obliquely rounded; whitish with black markings and numerous strigulae; a broad streak

from near apex parallel to termen to two-thirds dorsum; another from two-thirds costa joining subterminal streak; a short mark on one-third costa sometimes connected with subterminal streak; whole of wing closely strigulated except a narrow subcostal area; veins more or less brownish-ochreous; cilia white with black bars. Hindwings with termen slightly sinuate; white closely strigulated with black except a narrow terminal area; cilia white barred with fuscous except on tornus and dorsum. Nearest *X. spilota,* but very distinct.

South Australia: Yunta in January (W. M. Mules); two specimens received from Mr. F. E. Wilson, who has the type.

13. Xyleutes coscinopa Low.

Trans. Roy. Soc. S.A. 1900, p.63.

♂, 40 mm. Head whitish sprinkled with fuscous. Palpi one-half; dark fuscous. Antennae whitish; in male pectinated to two-thirds, pectinations 3, fuscous. Thorax fuscous sprinkled with whitish; with a blackish inverted U-mark. Abdomen grey with some whitish hairs. Legs grey; tarsi blackish with whitish rings. Forewings narrow, costa slightly sinuate, apex pointed, termen slightly round, very oblique; grey finely reticulated with fuscous; a broad fuscous median streak from base of costa to termen beneath apex, with a rounded median dorsal projection; costal area above this whitish reticulated with fuscous; cilia whitish with fuscous bars. Hindwings whitish with fuscous reticulaitons near costal and terminal edge; cilia whitish with some fuscous bars. I have described this from the type kindly lent me by Mr. Geo. Lyell. The wings are narrower than in *X. secta,* the forewings different and more distinct in markings.

North West Australia: Roeburne: Type in National Museum.

14. Xyleutes arachnophora n.sp.

Low. MS.

♂, 35 mm. Head and thorax fuscous. Palpi one-half; fuscous. Antennae whitish; in male pectinated to three-fourths, pectinations 3, fuscous. Abdomen grey. Legs whitish-fuscous. Forewings narrow, costa straight, apex pointed, termen slightly rounded, oblique; grey with numerous slender transverse blackish lines and strigulae; an outwardly oblique blackish mark beneath two-thirds costa, giving off a fine curved line, joining a subterminal line; cilia grey with blackish bars. Hindwings and cilia grey.

Victoria: Brentwood near Dimboola in March; one specimen. Type in National Museum.

15. Xyleutes epicycla n.sp.

ἐπικυκλος, marked with a circle.

♂ ♀, 40-48 mm. Head and thorax grey or fuscous. Palpi short (under one-half), very slender, closely applied to face; brown or fuscous. Antennae dark fuscous; pectinations in male 5, apical third simple. Abdomen grey. Legs fuscous. Forewings narrow, costa straight, apex pointed, termen oblique; grey with transverse fuscous lines and strigulae; a blackish circular discal spot at two-thirds; cilia grey

mixed with fuscous. Hindwings with termen sinuate, not rounded; grey; cilia grey. This and the next two species closely resemble those of the genus *Sympycnodes* but differ structurally in the median cell of the forewings, and the median cell and discocellulars of the hindwings.

QUEENSLAND: Toowoomba; Stanthorpe. NEW SOUTH WALES: Murrurundi; Gosford.

16. XYLEUTES EPISTICHA n.sp.

ἐπιστιχος, marked with (longitudinal) lines.

♂, 34-44 mm. Head and thorax fuscous finely sprinkled with whitish, appearing grey. Palpi 1; fuscous. Antennae fuscous: pectinations in male 4, apical two-fifths simple. Abdomen grey. Legs grey; tarsi dark fuscous with white rings. Forewings narrow, costa almost straight, apex pointed, termen oblique; grey with blackish lines and strigulae; in addition to the transverse markings there is a short blackish costal streak from base (rarely absent); also a short subcostal median streak; cilia grey, apices partly whitish, with sometimes a few fuscous bars towards tornus.

QUEENSLAND: Injune in January and February; eight specimens (W. B. Barnard). Type in Queensland Museum.

17. XYLEUTES RETICULOSA n.sp.

reticulosus, reticulated.

♂, 31-45 mm. Head and thorax fuscous. Palpi one-half; blackish. Antennae grey; pectinations in male 3, apical fourth simple, blackish. Abdomen grey. Legs fuscous; tarsi blackish with whitish rings. Forewings narrow, costa slightly arched, apex round-pointed, termen slightly rounded, oblique; grey, paler on costal margin and a transverse band at one-third, with numerous blackish transverse lines and some strigulae; cilia grey with whitish apices and blackish bars. Hindwings with termen slightly rounded; grey; cilia as forewings.

QUEENSLAND: Injune in January and February; six specimens (W. B. Barnard). Type in Queensland Museum.

18. XYLEUTES SECTA Luc.

Proc. Roy. Soc. Q. 1898, p.63.

♂, 38-60 mm. Head and thorax grey. Palpi fuscous. Antennae whitish or fuscous; pectinations in male 4, fuscous. Abdomen grey; a subapical grey-whitish patch on dorsum. Legs grey; tarsi fuscous with white rings. Forewings narrow, costa straight to near apex, apex pointed, termen very obliquely rounded; grey with numerous transverse fuscous strigulae; a slender irregular blackish line from base of costa to beneath apex; area between this and costa white with short blackish costal strigulae; cilia white with fuscous bars. Hindwings with termen sinuate; grey with a few darker strigulae; costa suffused with whitish; cilia as for forewings.

QUEENSLAND: Brisbane; Mt. Tamborine. SOUTH AUSTRALIA: Cradock. WEST AUSTRALIA: Waroona; Rottnest I.; Perth; Geraldton.

19. Xyleutes zophoplecta Turn.

Trans. Roy. Soc. S.A. 1902, p.202; Roths. Novit. Zool. 1903, Pl.11, f.10; Obthr. Lep. Comp. xi p.6, f.68; *polyplecta* Turn. Trans. Roy. Soc. S.A., 1932, p.195.

North Australia: Bathurst I. North Queensland: Townsville.

20. Xyleutes coscinophanes n.sp.

κοσκινοφανης, sieve-like.

♂ ♀, 52-60 mm. Head grey, lower half of face whitish; in male wholly whitish. Palpi 1; fuscous, lower edge grey. Antennae whitish; pectinations in male 4, fuscous. Thorax grey. Abdomen grey; in male whitish except tuft. Legs grey; tarsi dark fuscous with whitish rings. Forewings with costa slightly arched, apex rounded, termen obliquely rounded; grey closely reticulated with fuscous; white spots beneath three-fifths costa and above two-fifths dorsum; in male these are larger and more suffused; wing margins paler; cilia whitish with fuscous bars. Hindwings pale grey reticulated with darker grey; cilia as for forewings.

West Australia: Waroona in January (G. F. Berthoud); two specimens. Type in National Museum.

21. Xyleutes opposita Wlk.

xxxii, p.5891. *dictyoschema* Turn. Proc. Roy. Soc. Q. 1915, p.55; Obthr. Lep. Comp. xl, f.44-47.

North Queensland: Cairns. Queensland: Stanthorpe. New South Wales: Newcastle; Sydney. Victoria: Beaconsfield.

22. Xyleutes doddi Roths.

Novit. Zool. 1903, p.306, Pl.xi, f.11. *coscinota* Turn. Trans. Roy. Soc. S.A. 1903, p.24; Obthr. Lep. Comp. xl, f.28, 40, 53, 54.

North Australia: Darwin. North Queensland: Townsville.

23. Xyleutes nephocosma Turn.

Trans. Roy. Soc. S.A. 1902, p.201; Obthr. Lep. Comp. xl, f.51, 52. *molitor* Roths. Novit. Zool. 1903, p.307, Pl.xl. f.13.

North Australia: Cape York; Cairns; Townsville. Queensland: Injune.

24. Xyleutes methychroa Turn.

Ann. Q. Mus. x, 1911, p.131. *houlberti* Obthr. Lep. Comp. xl, f.56.

North Australia: Darwin. North Queensland: Atherton; Townsville. Queensland: Toowoomba; Injune; Talwood; Stanthorpe. Victoria:———

25. Xyleutes striga Roths.

Novit. Zool. 1903, p.307; Obthr. Lep. Comp. xi, f.55, 66. *acontucha* Turn. Trans. Roy. Soc. S.A. 1903, p.25.

North Queensland: Townsville. Queensland: Injune, Stanthorpe.

26. Xyleutes polyploca Turn.

Ann. Q. Mus. 1911, p.130; Obthr. Lep. Comp. xl, p.6, Pl. f.61-67.

North Australia: Darwin. North Queensland: Cairns; Mt. Mulligan. New South Wales: Brunswick Hds.

27. Xyleutes euplecta n.sp.

εὐπλεκτος, well woven.

♂, 66 mm. Head grey; face whitish. Palpi one-half; fuscous; lower surface white. Antennae white; pectinations in male 3 and a half; dark fuscous. Thorax fuscous; patagia and tegulae white sprinkled with fuscous. Abdomen whitish; a median stripe and terminal segments grey. Legs whitish; tarsi dark fuscous with white rings. Forewings narrow, costa straight, apex pointed, termen very oblique; grey-whitish with very numerous fine dark fuscous strigulae; a narrow costal strip from base to two-thirds white with few strigulae; cilia white with dark fuscous bars. Hindwings with termen scarcely rounded; white; a few terminal dark strigulae; cilia as for forewings.

West Australia: Carnarvon (Edmond Station) in June (J. C. Carnaby); one specimen. Type in Queensland Museum.

28. Xyleutes polyspora n.sp.

πολυσπορος, many-spotted.

♂, 60 mm. Head fuscous mixed with whitish. Palpi 1; dark fuscous, beneath whitish. Antennae whitish; in male bipectinate to four-fifths, pectinations 5, fuscous. Thorax fuscous mixed with whitish; with a black inverted U-mark. Abdomen whitish barred with dark fuscous. Forewings narrow, costa almost straight, apex rounded, termen very obliquely rounded; pale grey with a broad longitudinal central shade before middle whitish; the whole wing closely packed with minute blackish strigulae beneath median shade; several shorter narrower similar streaks between veins in terminal area; cilia white with blackish bars. Hindwings with termen slightly sinuate; white with some faint fuscous bars.

South Australia: Wardang I. (W. M. Mules); one specimen lent for description by Mr. F. E. Wilson, who has the type.

29. Xyleutes tanyctena n.sp.

ταυυκτενος, with long combs.

♂, 108 mm. Head grey. Palpi 1; grey. Antennae ochreous-whitish; pectinations in male 5, fuscous, terminal eighth only simple. Thorax grey with an inverted blackish V-mark. Abdomen white, towards apex grey. Legs grey. Forewings elongate, costa straight to middle, thence arched, apex round-pointed, termen nearly straight, oblique; whitish strigulated, and towards costa and dorsum broadly suffused, with fuscous, leaving a median whitish stripe; towards termen grey reticulated with fuscous; cilia fuscous, apices partly whitish. Hindwings with termen slightly rounded; white, towards apex grey-whitish; terminal edge reticulated with fuscous and with fuscous dots on ends of veins; cilia white, on dots fuscous.

Queensland: Morven (R. E. Barnard); one specimen. Type in Queensland Museum.

30. Xyleutes pycnosticta n.sp.

πυκνοστικτος, densely spotted.

♂, 56-88 mm. Head fuscous. Palpi 1; fuscous. Thorax brownish with an inverted blackish U-mark; patagia sometimes white with a blackish median bar; tegulae sometimes whitish. Abdomen whitish; apices of segments blackish. Forewings narrow, costa slightly arched, apex rounded, termen obliquely rounded; grey coarsely spotted and towards termen reticulated with blackish; apical part of costa and a broad streak along fold sometimes white; cilia white with blackish bars. Hindwings with termen slightly rounded; whitish faintly reticulated with grey; cilia whitish, sometimes with fuscous bars.

South Australia: Wardang I. (W. M. Mules). West Australia: Three specimens. Type in Queensland Museum.

31. Xyleutes leucomochla Turn.

Proc. Roy. Soc. Q. 1915, p.55.

♂, 110-138 mm. Head grey. Antennae brownish-fuscous; pectinations in male 8. Thorax white partly suffused with grey; an inverted V-mark and posterior margin blackish. Abdomen white, bases of segments partly grey and partly fuscous. Legs brownish-fuscous. Forewings with costa straight to two-thirds, thence arched, apex pointed, termen almost straight, oblique; fuscous or grey with blackish strigulae; a broad white median bar from base to two-thirds, there angled and continued to apex; sometimes this bar is incompletely developed, sometimes it is joined on costal side of angle by an irregular white streak; veins brown; a blackish oblique streak from beneath apex to angle of bar more or less developed; cilia blackish or grey, apices partly white. Hindwings white; terminal area reticulated with fuscous or grey.

Victoria: Nhill in December. West Australia: Cunderdin; Lake Darlott, Eastern Murchison; three specimens. The type is in the National Museum.

32. Xyleutes vittata Wlk.

vii. p.1541. *Zeuzera congerens* Swin. i, p.282, Pl.8, f.5.

♂, 55-70 mm. Head whitish; face orange. Palpi under 1; fuscous. Antennae fuscous; pectinations in male 4, apical third simple. Thorax whitish, with central streak and lateral streaks on tegulae fuscous mixed with orange. Abdomen fuscous, sometimes mixed with whitish, apices of segments orange, underside more whitish. Legs fuscous; coxae mixed with whitish. Forewings narrow, costa gently and evenly arched, apex rounded, termen very obliquely rounded; whitish; costal border spotted and strigulated with dark fuscous; a subcostal spot at two-thirds fuscous mixed with orange, confluent with costal series of spots; a submedian series of confluent dark fuscous spots along lower margin of cell, then curved upwards to apex; a more or less distinct orange streak along lower margin of cell and base of vein 2; a dorsal series of confluent spots from near base to tornus; a terminal series of spots on veins, sometimes connected by strigulae with median series of spots; cilia whitish barred with fuscous opposite spots. Hindwings pale fuscous, sometimes partly suffused with whitish; cilia whitish barred with pale fuscous.

Described from three examples, including the type, in the British Museum. There is also an example in the National Museum, Melbourne.

West Australia: Perth; Bridgetown.

33. Xyleutes decorata Swin.

Cat. Oxf. Mus. i. p.281.

♂, 100 mm. ♀, 127 mm. Head whitish. Palpi dark fuscous. Antennae whitish; pectinations in male 6, dark fuscous. Thorax dark fuscous; patagia and tegulae whitish. Abdomen whitish; apices of segments dark fuscous. Legs dark fuscous with whitish rings. Forewings rather narrow, costa straight to near apex, apex round-pointed, termen slightly rounded, oblique; dark fuscous with numerous circular whitish spots; a costal series of small spots and strigulae, some confluent; beyond middle a subcostal series of larger confluent spots; a median series beneath cell; dorsal, subterminal, and terminal series; cilia dark fuscous with whitish bars. Hindwings with termen sinuate; whitish; cilia whitish with dark fuscous bars.

West Australia: Perth; Corrigin; Geraldton; Mullewa.

34. Xyleutes pulchra Roths.

Novit. Zool. 1896, p.232, & 1897, Pl.7, f.2; Obthr. Lep. Comp. xl, f.48, 49.

♂, 74 mm. Head whitish-grey. Palpi 1, closely appressed to face; dark fuscous, lower surface white. Antennae whitish-grey; pectinations in male 4, dark fuscous, apical two-fifths simple. Thorax whitish-grey sprinkled with fuscous and with an inverted blackish V-mark. Abdomen dark fuscous; a median series of dots and dorsum of terminal segments whitish-grey; first segment with a pair of lateral whitish tufts. Legs whitish; tarsi dark fuscous with whitish rings. Forewings narrow, costa straight to three-fourths, thence slightly arched, apex pointed, termen slightly rounded, strongly oblique; whitish-grey with blackish strigulae most numerous on costa and near termen; a small elongate blackish mark in disc at three-fifths; one or two blackish subterminal dots beneath apex; cilia white with blackish bars.

♀, differs as follows: 125 mm. Thorax with interior of V-mark filled in with blackish. Forewings proportionately broader, elongate-oval, costa moderately arched; blackish markings much exaggerated; a blotch filling posterior half of cell; two large elongate spots beneath cell, with a smaller spot beneath the first; a series of elongate subterminal spots. Hindwings with termen rounded, not sinuate.

Queensland: Brisbane.

35. Xyleutes stenoptila Turn.

Ann. Q. Mus. 1911, p.131.

North Queensland: Atherton.

36. Xyleutes nubila n.sp.

nubilus, cloudy.

♂, 90-106 mm. Head and thorax whitish-grey. Palpi blackish; lower surface white. Antennae whitish; pectinations in male 5, dark fuscous, apical two-fifths simple. Abdomen whitish-grey; a pair of white lateral tufts on first segment. Legs whitish: tarsi fuscous with whitish rings. Forewings narrow, straight to three-fourths, thence slightly arched, apex pointed, termen straight, very oblique: whitish-grey with grey markings, or rarely markings fuscous; a broad suffusion beneath costa near base, enclosing a small whitish elongate spot beneath

one-third costa, dark area broadly expanded in disc, continued by a narrow prolongation to termen beneath apex; cilia whitish-grey. Hindwings with termen straight; fuscous: towards tornus pale grey, on costa narrowly white; cilia white.

♀, 142-170 mm. Head and thorax dark grey or fuscous. Antennae grey. Abdomen grey becoming whitish-grey towards apex; without basal white tufts. Forewings proportionately broader, costa more evenly arched; markings similar but less distinct. Hindwings darker grey suffused with fuscous towards base.

QUEENSLAND: Duaringa in November and December; Injune in October and November: Talwood in January (W. B. Barnard), a series bred. Type in Queensland Museum.

37. XYLEUTES DONOVANI Roths.

Novit. Zool. 1897, p.307, Pl.8, f.2. *cretosa* Luc. Proc. Roy. Soc. Q. 1898, p.62.

♂, 72-100 mm. ♀, 94-135 mm. Head whitish. Palpi 1; fuscous-brown. Antennae whitish; pectinations in male 5, dark fuscous. Thorax brown edged by an inverted blackish U-mark; patagia grey; tegulae white. Abdomen fuscous; bases of segments whitish; apices brown. Legs whitish sprinkled with fuscous; tarsi dark fuscous with white rings. Forewings elongate, costa straight to two-thirds, thence slightly arched, apex pointed, termen strongly oblique; white with some grey suffusion and numerous dark fuscous strigulae; these coalesce into small dark areas on costa at one-third and two-thirds; similarly formed is a broad dark streak intersected by veins from beneath apex to dorsum before middle; cilia whitish with broad dark fuscous bars. Hindwings with termen sinuate; fuscous; a whitish terminal band containing fuscous strigulae; cilia as forewings.

NORTH QUEENSLAND: Cairns. QUEENSLAND: Brisbane; Tweed Hds.; Toowoomba. VICTORIA: Moe.

38. XYLEUTES DIAPLECTA n.sp.

διαπλεκτος, interwoven.

♂, 60-64 mm. ♀, 70-80 mm. Head and thorax whitish sprinkled with fuscous, appearing grey. Palpi one-half; grey. Antennae grey; pectinations in male 4, dark fuscous, apical two-fifths simple. Abdomen fuscous. Forewings narrow, costa gently arched, apex rounded, termen obliquely rounded; pale grey with blackish transverse lines and strigulae; a broad blackish stripe from base of costa almost to termen beneath apex; along costal edge of this a broad white suffusion containing few strigulae; along its dorsal edge a broad dark grey suffusion; cilia white with fuscous bars. Hindwings with termen slightly rounded; fuscous; cilia as for forewings.

QUEENSLAND: Five specimens all of ancient date, one labelled August, the others undated. Type in Queensland Museum.

39. XYLEUTES EURYPHAEA n.sp.

εὐρυφαιος, broadly dark.

♂ ♀, 58-68 mm. Head dark fuscous. Palpi 1; dark fuscous. Antennae whitish; bipectinate in both sexes, pectinations in male 4, in female 2, apical third simple. Thorax in male fuscous with an inverted blackish

V-mark, tegulae white; in female grey. Abdomen fuscous, paler in male, towards apex grey. Legs grey; tarsi blackish with white rings. Forewings narrow, costa straight in male, in female moderately arched, apex round-pointed, termen very obliquely rounded; grey with a few fuscous strigulae; a broad dark fuscous band from base of costa, on which it extends to one-third, to lower half of termen; a dark fuscous mark on two-thirds costa; cilia whitish with dark fuscous bars. Hindwings with termen slightly rounded; in male whitish, in female dark grey; cilia as for forewings.

QUEENSLAND: Injune in October, November, and January (W. B. Barnard); four specimens. Type in Queensland Museum.

40. XYLEUTES PUNCTIFIMBRIA Wlk.

xxxii, p.588.

♂, 70-86 mm. Head and palpi fuscous. Antennae fuscous; pectinations in male 5, apical third simple. Thorax grey with an inverted blackish V-mark. Abdomen brownish-grey with numerous dark fuscous transverse bars on dorsum. Legs fuscous; coxae and femora grey. Forewings elongate, costa straight to near apex, apex round-pointed, termen nearly straight, strongly oblique; whitish, densely spotted and strigulated with blackish between veins; these strigulae are evenly distributed and do not form blotches; cilia whitish with blackish bars. Hindwings whitish; sometimes a few fine blackish strigulae towards termen; cilia as forewings. Something like *X. doddi,* but the strigulae are blackish not grey, and there are no blotches.

QUEENSLAND: Brisbane. By some mischance specimens sent by Mr. Diggles from Brisbane were attributed by Walker to "Swan River."

41. XYLEUTES BIPUSTULATA Wlk.

xxxii, p.585.

♀, 76 mm. Head, palpi, antennae, and thorax dark fuscous. Abdomen dark fuscous; apices of segments whitish. Legs fuscous. Forewings oval, costa rather strongly arched, apex rounded, termen obliquely rounded; fuscous finely strigulated with blackish; in posterior area the strigulae form a fine net-work; a square blackish spot at end of cell beneath two-thirds costa; cilia fuscous, bases paler, apices barred with white. Hindwings uniformly fuscous; cilia as forewings.

This species is unknown to me. The description was taken from the type in the British Museum. Its locality is given as Australia. It is larger and broader winged than *X. zophoplecta,* without any whitish suffusion in disc.

42. XYLEUTES LEUCOLOPHA n.sp.

λευκολοφος, with white tufts.

♂, 68-100 mm. ♀, 90-138 mm. Head and palpi fuscous. Antennae whitish; pectinations in male 5, dark fuscous, apical half simple. Thorax fuscous-grey with an inverted blackish U-mark. Abdomen fuscous-grey; a pair of lateral white tufts on first segment. Legs grey; tarsi dark fuscous with whitish rings. Forewings narrow in male, in female rather broader, costa nearly straight, apex round-pointed, termen slightly rounded, oblique; fuscous-grey sparsely sprinkled with white; numerous dark fuscous strigulae, broader on costa and in terminal area; an

inwardly oblique series of dark fuscous spots from beneath apex; cilia white with fuscous bars. Hindwings with termen slightly rounded; in male white; in female dark grey; in both sexes with slender fuscous strigulae; cilia as for forewings.

QUEENSLAND: Injune in December and January (W. B. Barnard); eight specimens. Type in Queensland Museum.

43. XYLEUTES DIDYMOPLACA n.sp.

διδυμοπλακος, twin-blotched.

♀, 100 mm. Head whitish. Palpi 1; whitish. Antennae grey. Thorax whitish, anterior edge fuscous; with an inverted fuscous V-mark. Abdomen whitish; apices of segments pale grey; tuft ochreous-whitish. Legs whitish; tarsi dark fuscous with whitish rings. Forewings moderately broad, costa gently arched, termen slightly rounded, oblique; grey-whitish strigulated and reticulated with fuscous; a short oblong fuscous blotch beneath basal eighth of costa; a pair of irregular confluent fuscous blotches, first median resting on fold beyond middle, expanded in mid-disc, continued by an oblique process ending abruptly beneath one-third costa; second at two-thirds, of roughly similar shape, but with costal process giving out a short serrate longitudinal line, posterior edge oblique and prolonged to beneath apex; costa and area between blotches strigulated; terminal area finely reticulated; a terminal series of dots; cilia whitish, on dots fuscous. Hindwings whitish; strigulae scarcely indicated; cilia whitish.

WEST AUSTRALIA: Waroona in November (G. F. Berthoud); one specimen. Type in National Museum.

44. XYLEUTES LICHENEA Roths.

Novit. Zool. 1896, p.601; Obthr. Lep. Comp. xl., f.26, 27, 41-43, 69, 70. *olbia* Turn. Proc. Roy. Soc. Q. 1915, p.54.

NORTH QUEENSLAND: Atherton. QUEENSLAND: Brisbane.

45. XYLEUTES MACKERI Obthr.

Lep. Comp. xi., p.49, f.14, 15.

♂, 130 mm. Head fuscous-brown. Palpi 1; dark fuscous. Antennae dark fuscous; pectinations in male 1 and a half. Thorax fuscous-brown with an inverted blackish U-mark, lateral portions of patagia whitish. Abdomen grey-brown. Legs fuscous-brown; tibiae and tarsi dark fuscous. Forewings moderately broad, costa straight to three-fourths, thence arched, apex rounded, termen straight, oblique; brownish with numerous dark fuscous strigulae, which form a fine network in terminal area; a broad whitish stripe in cell from base to one-fourth; a larger whitish area on middle third of costa, on costa suffused, sharply defined in disc; a whitish elongate patch expanding from apex to disc at two-thirds; terminal area whitish with a fine dark fuscous network traversed by brown veins; cilia brown. Hindwings with termen nearly straight; fuscous-brown; terminal area whitish with fine fuscous network; cilia brown.

NORTH QUEENSLAND: Cairns.

46. Xyleutes phaeocosma Turn.

Ann. Q. Mus. x, p.130; Obthr. Lep. Comp. xi, f.16-19.

North Australia: Darwin. North Queensland: Cairns.

47. Xyleutes platyphaea n.sp.

πλατυφαιος, broadly fuscous.

♀, 134–142 mm. Head fuscous. Palpi 1; dark fuscous; lower surface whitish. Antennae grey. Thorax fuscous, lateral and posterior margins grey. Abdomen fuscous; terminal segments grey. Legs grey; tarsi fuscous with whitish rings. Forewings moderately broad, costa gently arched, apex round-pointed, termen nearly straight, oblique; grey with dark fuscous markings and strigulae; costal edge rather closely strigulated; an irregular blotch on base of costa; an oblique wedge, narrow on costa at one-fourth, broadening to beneath middle of disc, there deflected and forming a narrower irregular wedge to apex; dorsal area to middle with long strigulae; terminal area finely reticulated; a terminal series of dots on veins; cilia white, on dots fuscous. Hindwings with termen rounded; pale fuscous; terminal dots and cilia as for forewings.

Queensland: Stanthorpe in December; two specimens (W. B. Barnard). Type in Queensland Museum.

48. Xyleutes duponcheli Newm.

Tr. E.S. (2), iii, p. 282. *tenebrifer* Wlk. xxxii, p. 585; Obthr. Lep. Comp. xi, f. 35-37. *alboatra* Wlk. xxxii, p. 589.

♂, 92 mm. ♀, 116-160 mm. Head fuscous-brown. Palpi 1, ascending; fuscous-brown. Thorax fuscous-brown with a slender inverted blackish U-mark. Abdomen in male whitish, in female brown, in both sexes fuscous towards apex. Legs fuscous-brown; tarsi dark fuscous. Forewings rather narrow, costa slightly arched, apex round-pointed, termen slightly rounded, strongly oblique; in male pale grey, in female darker, in both closely strigulated and towards termen reticulated with blackish; sometimes a suffused darker area beneath two-thirds costa, and another above dorsum about middle; usually an oblique subterminal series of oblong dark spots; cilia brownish. Hindwings with termen slightly rounded; in male white strigulated on terminal edge, cilia fuscous; in female reddish-brown with pale fuscous strigulae, cilia brownish, apices partly white.

North Queensland: Cooktown; Townsville; Mackay. Queensland: Yeppoon; Brisbane, Mt. Tamborine. North-West Australia: Broome.

49. Xyleutes sordida Roths.

Novit. Zool. 1891, p. 601. *turneriana* Obthr. Lep. Comp. xl, p. 52, f.23-25, 38, 39. *columbina* Luc. Proc. Roy. Soc. Q. 1898, p. 64.

♂, 74–96 mm. ♀, 100–104 mm. Head grey. Palpi one-half, appressed to face; blackish, lower surface whitish. Antennae grey-whitish; pectinations in male 5, blackish, apical half simple. Thorax grey with an inverted blackish V-mark, of which the interior is sometimes filled with dark fuscous. Abdomen fuscous; terminal segments and tuft whitish-grey; apices of segments usually whitish. Legs whitish; tarsi fuscous with whitish rings. Forewings narrow, somewhat broader in female, costa in male straight to three-fourths, thence slightly arched, in female

evenly arched, apex pointed, termen almost straight, oblique; grey sprinkled with whitish; fuscous spots more or less developed; sometimes a large spot in cell; another large spot above two-thirds dorsum, usually connected by a series of smaller spots to beneath three-fifths costa; an oblique subterminal series of spots; cilia white. Hindwings with termen slightly rounded; grey in male; in female fuscous; cilia white.

North Queensland: Cairns. Queensland: Brisbane; Injune, Milmerran. Victoria: Moe.

50. Xyleutes liturata Don.

Ins. N. Holl. p. 4, Pl. 37, f. 1; Obthr. Lep. Comp. xi, f. 20–22. *casuarinae* H–Sch. Lep. Exot. f. 162.

♂, 64-184 mm. ♀, 180-200 mm. Head brownish. Palpi 1, porrect; fuscous. Antennae grey-whitish or brown-whitish; pectinations in male 5; dark fuscous, apical two-fifths simple. Thorax brown with an inverted blackish U-mark and a slender whitish median longitudinal grey line. Abdomen brownish-fuscous; apices of segments and whole of terminal segments whitish or grey. Forewings elongate-triangular, costa slightly arched, apex round-pointed, termen slightly rounded, strongly oblique; whitish closely strigulated and near termen reticulated with blackish; markings blackish; a stripe on middle of fold; a spot beneath middle of cell; two longitudinal subcostal stripes at two-thirds more or less developed; an oblique subterminal series of elongate spots; cilia brownish. Hindwings with termen gently rounded; fuscous-brown; towards termen whitish in male; and in both sexes reticulated with blackish; cilia whitish with fuscous or brownish bars.

North Queensland: Cairns. Queensland: Brisbane; Bunya Mts.; Injune. New South Wales: Uki; Sydney. Victoria: Melbourne; Moe. Tasmania: Launceston; Strahan; Hobart. West Australia: Perth.

51. Xyleutes durvillei H-Sch.

Ausser. Schmet. f. 63; Obthr. Lep. Comp. xi, f. 58–60. *eucalypti* H–Sch. Ausser. Schmet. f. 163, 164. *angasii* Feld. Pl. 81, f. 4. *fuscus* Swin. Cat. Oxf. Mus. i, p. 280.

♂, 128–160 mm.; ♀, 170–210 mm. Head brown sprinkled with white; face brown. Palpi 1; brown. Antennae brown-whitish; pectinations in male 4, dark fuscous, apical third white. Thorax brown with an inverted blackish U-mark; patagia and tegulae fuscous sprinkled with white. Abdomen brown or fuscous; apices of segments white; first segment with a pair of white tufts. Forewings elongate, costa straight to three-fourths, thence arched, apex round-pointed, termen slightly rounded; oblique; brown, on termen and tornus grey, with numerous blackish strigulae; a suffused white median stripe from base to middle; a short white streak or spot in end of cell; sometimes a broad white oblique suffusion from apex to near middle of disc; cilia brown, sometimes with white bars. Hindwings with termen rounded; brown, strigulated with fuscous except towards base; cilia white with brown bars, on dorsum and tornus wholly white.

Queensland: Toowoomba. New South Wales: Newcastle; Sydney.

52. Zyleutes edwardsi Tepp.

Trans. Roy. Soc. S.A. 1891, p. 163, f. 1, Pl. 1; Obthr. Lep. Comp. xl, f. 29–31.

♂, 134 mm. ♀, 110–146 mm. Head grey. Palpi 1; grey. Antennae whitish-grey; pectinations in male 4, brownish, apical half simple. Thorax grey sprinkled with whitish, usually with an inverted fuscous U-mark. Abdomen grey. Forewings narrow in male, in female somewhat broader, apex round-pointed, termen slightly rounded, strongly oblique; grey sprinkled with white; usually without markings, but sometimes with faintly darker suffusion beneath costa and before termen; cilia white. Hindwings with termen slightly rounded, in male sinuate; fuscous; cilia white.

Queensland: Stanthorpe; Dalby; Injune. Victoria: Gisborne.

53. Xyleutes affinis Roths.

Novit. Zool. 1896, p. 600; Obthr. Lep. Comp. xl, f. 10-13. *magnifica* Roths.

♂, 102-160 mm. ♀, 180-210 mm. Head grey. Palpi appressed to face; blackish, lower surface whitish. Antennae whitish; pectinations in male 4, dark fuscous, apical half simple. Thorax grey; sometimes with indications of an inverted U-mark. Abdomen reddish-brown, with a central grey line from base, widening to include whole of dorsum of terminal segments. Forewings elongate, costa straight to two-thirds, thence arched, in female evenly arched, apex round-pointed, termen slightly rounded, strongly oblique; grey; sometimes without markings, but usually with fuscous spots; a spot in cell, two elongate spots above and beneath middle of disc; posterior to these an oblique series of spots; an oblique subterminal series of elongate spots; cilia grey, sometimes with fuscous bars. Hindwings with termen slightly rounded; reddish-brown; cilia whitish, sometimes with brown bars.

North Queensland: Cairns. Queensland: Brisbane; Mt. Tamborine; Toowoomba; Stanthorpe. New South Wales: Sydney.

54. Xyleutes boisduvali Roths.

Novit. Zool. 896, p.232; Obthr. Lep. Comp. xl, f.5-8.

♂, 110-165 mm. ♀, 220 mm. Head grey. Palpi appressed to face; blackish, lower surface whitish. Antennae whitish; pectinations in male 4, fuscous-brown, apical half simple. Thorax grey with an inverted blackish U-mark. Abdomen fuscous; terminal segments grey. Legs whitish; tarsi fuscous with white rings. Forewings elongate, costa gently arched, apex round-pointed, termen nearly straight, strongly oblique; grey; sometimes without markings, but usually fuscous markings are more or less developed; a spot near base beneath cell; an oblique post-median series of elongate spots, and a similar subterminal series; cilia white. Hindwings with termen slightly rounded; dark fuscous; cilia white.

North Queensland: Cairns; Atherton; Burdekin R. Queensland: Brisbane; Toowoomba; Injune; Milmerran; Stanthorpe. New South Wales: Barellan; Tamworth; Sydney; Tuncurry.

55. Xyleutes perigypsa Low.

Proc. Linn. Soc. N.S.W. 1915, p.479.

Unknown to me.

New South Wales: Broken Hill.

56. Xyleutes pentasema Low.

Zeuzera (?) *pentasema* Low. Proc. Linn. Soc. N.S.W. 1915, p.478.

Unknown to me.

Queensland: Dalby.

4. Gen. ZEUZERA Latr.

Hist. Nat. xxiv, p.186.

Palpi obsolete. Antennae in male bipectinate to middle. Tibiae without spurs. Forewings with areole long, strongly projecting posteriorly, median cell present, 6 from cell or areole, 7 and 8 stalked, 9 connate or short-stalked, 11 from near base of areole. Hindwings with all veins separate, 12 connected by a bar with upper angle of cell. Type *Z. pyrina* Linn. from Europe.

57. Zeuzera aeglospila Turn.

Proc. Roy. Soc. Q. 1915, p.53.

North Queensland: Cairns.

58. Zeuzera quieta Turn.

Trans. Roy. Soc. S.A. 1932, p.194.

North Queensland: Cape York. North West Australia: Wyndham.

5. Gen. NEPIOMORPHA nov.

νηπιομορφος, infantile.

Palpi very short, closely appressed to face. Antennae in male bipectinate, towards apex simple. Tibiae hairy. Forewings with areole moderate, strongly projecting posteriorly, median cell small, 4 and 5 connate from angle, 7 and 8 long-stalked, 9 short-stalked, 11 from cell shortly before areole. Hindwings with median cell present, veins separate, 11 arising from cell beyond middle and running into subcostal.

59. Nepiomorpha cineraria n.sp.

cinerarius, grey.

♂, 29 mm. Head and thorax whitish-grey. Palpi dark fuscous. Antennae pale grey; pectinations in male 3, brownish, apical half simple. Abdomen grey. Legs grey; tarsi dark fuscous with whitish rings. Forewings narrow, costa slightly arched; apex round-pointed, termen very obliquely rounded; whitish-grey with numerous transverse fuscous lines and strigulae; a dark fuscous costal streak from base to one-third; cilia whitish with fuscous bars. Hindwings with termen scarcely rounded; pale grey with a few darker strigulae towards termen; cilia pale grey.

North Queensland: Cape York in November (W. B. Barnard); one specimen. Type in Queensland Museum.

6. Gen. BRACHYCYTTARA nov.

βραχυκυτταρος, with short cells.

Palpi 1; porrect. Antennae in female simple. Tibiae without spurs. Forewings with areole and median cell short, 7 and 8 stalked, 11 from cell far before areole. Hindwings with short median cell, all veins separate. Type *B. cyclospila.*

60. Brachycyttara cyclospila n.sp.

κυκλοσπιλος, with circular spots.

♀, 42 mm. Head and thorax fuscous. Abdomen grey; tuft whitish. Legs grey. Forewings with costa almost straight, apex rounded, termen obliquely rounded; fuscous-grey with slender fuscous strigulae; a circular blackish discal spot at three-fifths; a darker basal patch to one-fourth, edged posteriorly by a whitish suffusion; a small circular blackish spot just above two-thirds dorsum; a whitish subcostal suffusion before apex; a terminal series of fuscous dots; cilia grey. Hindwings with termen gently rounded; pale grey; cilia pale grey.

West Australia: Perth; two specimens. Type in Queensland Museum.

7. Gen. PTILOMACRA Wlk.

v, p.1098.

Palpi short, porrect, hairy; terminal joint short, obtuse. Antennae bipectinate to apex in both sexes. Thorax and abdomen densely hairy. Tibiae without spurs. Forewings with areole long, narrow, not projecting; median cell long and narrow; 7 and 8 separate or stalked, 11 from cell before areole. Hindwings with triangular median cell; all veins separate.

61. Ptilomacra senex Wlk.

Wlk. vii, p.1098. *longicornis* Wlk. vii, p.1522.

♂, 46-70 mm. ♀, 84-104 mm. Head and palpi fuscous. Antennae fuscous; pectinations in male 8. Thorax fuscous with a pair of short white antemedian diverging streaks. Abdomen fuscous. Legs fuscous; tarsi with whitish rings. Forewings elongate-triangular, costa straight to near apex, apex rounded-rectangular, termen slightly rounded, slightly oblique; fuscous with dark fuscous markings; a suffused spot at one-fourth below middle, followed by a grey-whitish patch; a subcostal spot at one-third preceded by a grey-whitish patch; a suffused line from four-fifths costa bisinuate to two-thirds dorsum; cilia fuscous. Hindwings with termen rounded; fuscous; cilia fuscous.

New South Wales: Newcastle; Sydney; Jervis Bay. Victoria: Beaconsfield; Moe. South Australia: Adelaide; Mt. Lofty.

8. Gen. IDIOSES Turn.

Proc. Roy. Soc. Tas. 1926, p.162.

Palpi short, porrect. Thorax without crest. Forewings without areole, 7, 8, 9 stalked from upper angle of cell, 10 and 11 separate. Hindwings with cell over one-half, median cell absent, all veins separate except 6 and 7, which are connate. The position of this genus is uncertain, as no mention of the tibial spurs is contained in its original description, and I am unable to re-examine the type. I think, however, that it comes near *Charmoses.*

62. Idioses littleri Turn.

Ibid., p.163.

Tasmania: Launceston.

9. Gen. CHARMOSES Turn.

Trans. Roy. Soc. S.A. 1932, p.194.

Face with anterior tuft. Palpi 1 and a half, porrect. Antennae in male bipectinate to apex, in female simple. Tibiae with well-developed spurs. Forewings without median cell, 7 and 8 stalked, 11 from areole. Hindwings without median cell, probably from coalescence with the acutely indented discocellulars as in *Macrocyttara,* 6 and 7 connate.

63. Charmoses dumigani Turn.

Ibid., p.194.

Queensland: Toowoomba; Carnarvon Rge.

10. Gen. TRIGONOCYTTARA nov.

τριγονοκυτταρος, with triangular cell.

Palpi very short, slender, shortly hairy. Antennae of male biciliated in tufts. Thorax with rounded posterior crest. Tibiae with long slender spurs. Forewings with forked median vein in cell, median cell long, areole small, triangular, not projecting, 2 and 3 separate, 3 and 4 remote, 4 and 5 separate, 6 from middle of cell, 7 from lower angle of areole, 8 and 9 coincident, 10 from areole, 11 from near middle of cell, free. Hindwing with forked median vein in cell, median cell short, triangular, 2, 3, 4 remote, 4 and 5 approximated at origin, 6 and 7 separate, slightly diverging, 12 free.

64. Trigonocyttara clandestina n.sp.

clandestinus, hidden.

♂, 20-28 mm. Head and palpi fuscous. Antennae fuscous; ciliations in male 1. Thorax dark fuscous. Abdomen fuscous. Legs fuscous with white rings on tarsi. Forewings elongate, suboval, costa gently arched, apex rounded, termen obliquely rounded; grey, often suffused with whitish on costa and dorsum, with numerous fuscous transverse lines and strigulae; cilia grey with an occasional white scale. Hindwings with termen slightly rounded; fuscous; cilia grey, sometimes whitish except on apex, tornus, and dorsum.

Queensland: Toowoomba and Stanthorpe in February (W. B. Barnard); five specimens. Type in Queensland Museum.

11. Gen. COSSODES White.

Grey's J. Exped. Discov. p.477.

Head with strong anterior tuft. Palpi slightly over 1, densely rough-haired; terminal joint minute. Antennae simple in both sexes. Tibial spurs well developed. Forewings with areole and median cell narrow, 7 and 8 connate or stalked, other veins separate, 11 from well before areole. Hindwings with median cell, all veins separate.

In this genus as in *Dudgeonea, Archaeoses,* and *Macrocyttara* the areole is completed not by an anastomosis but by the primitive interradial cross-vein.

65. Cossodes lyonetii White.

Ibid., p.477.

♂ ♀, 58-60 mm. Head dark fuscous. Palpi 1 and a half; in male smooth-scaled, appressed to face, terminal joint short, obtuse; in female rough-haired, terminal joint hidden. Antennae blackish. Thorax fuscous or blackish. Abdomen fuscous or blackish; apices of segments partly ochreous-whitish. Legs dark fuscous. Forewings elongate-triangular, costa moderately arched, apex rounded, termen obliquely rounded; blackish; markings well defined, ochreous-whitish but variable; a subcostal streak from base to near termen, there bent upwards to end on apex; indented beneath or interrupted before and beyond middle; a submedian spot beneath middle of disc, another before tornus, the two sometimes connected; sometimes a broad dorsal streak from base almost reaching median spot; a terminal series of small spots; cilia fuscous. Hindwings with termen rounded; blackish; cilia ochreous-whitish.

West Australia: Albany; Waroona; Pinjarrah; Jindong.

12. Gen. DUDGEONEA Hmps.

Journ. Bombay Nat. Hist. Soc. xiii, p.227.

Palpi long (male 1 and a half, female 2), thickened with appressed scales; second joint very long; terminal joint short, obtuse. Antennae simple in both sexes. Thorax with a bifid posterior crest. Tibial spurs well developed. Forewings with areole rather small, median cell present, all veins separate, 11 from much before areole. Hindwings with small median cell, all veins separate.

66. Dudgeonea lychnocyla, n.sp.

λυχνοκυκλος, with shining circles.

♂, 30-34 mm. Head white; face with a transverse brown line above middle. Palpi reddish-brown; beneath whitish. Antennae fuscous. Thorax reddish-brown; tegulae except base shining white; crest partly whitish. Abdomen brown. Legs pale brown. Forewings suboval, costa strongly arched, apex rounded, termen obliquely rounded; brown; three clusters of closely aggregated shining white circular spots; first cluster subcostal extending to middle, containing two rows of spots; second dorsal, triangular, extending to three-fourths dorsum; between these is a longitudinal brown streak; third apical, from two-thirds costa to mid-termen, containing two large and many small spots; central brown area neatly defined; cilia brown, on spots white. Hindwings with termen rounded; brownish; some small whitish spots on apical half of termen; cilia brownish.

Queensland: Carnarvon Rge. in December; five specimens (W. B. Barnard). Type in Queensland Museum.

67. Dudgeonea actinias Turn.

Trans. Roy. Soc. S.A. 1902, p.202.

North Queensland: Cape York; Townsville.

68. Dudgeonea polyastra Turn.

Trans. Roy. Soc. S.A. 1933, p.171.

Queensland: Yeppoon.

13. Gen. ARCHAEOSES Turn.

Trans. Roy. Soc. S.A. 1893, p.196.

Palpi rather slender, smooth, obliquely ascending; second joint long; terminal joint short, obtuse. Antennae simple. Thorax with rough anterior crest. Tibiae with spurs well developed. Forewings with areole short, narrow, not projecting, median cell short, upper primary branch dividing before discocellulars into first and second median, all veins separate, 11 from before areole. Hindwings with median cell short, all veins separate.

69. Archaeoses polygrapha Low.

Trans. Roy. Soc. S.A. 1893, p.148. *neurotenes* Turn. Trans. Roy. Soc. S.A. 1932, p.196.

Queensland: Brisbane; Dalby; Miles; Injune; Adavale; Cunnamulla. New South Wales: Broken Hill. Victoria: Brentwood; Sale. South Australia: Adelaide; Cradock; Yunta.

14. Gen. CULAMA Wlk.

vii, p.1524.

Head with tuft of scales on dorsum. Palpi long, obliquely ascending, smooth-scaled; terminal joint short, obtuse. Antennae in male bipectinate to apex, in female shortly bipectinate or simple. Thorax without crest. Tibiae with well-developed spurs. Forewings with areole and median cell rather narrow, 8 and 9 stalked, 7 stalked, connate or separate, 11 from areole. Hindwings with median cell narrow, upper branch of median short, running into a sharp angle of the discocellulars, 6 and 7 connate or stalked. Type *C. australis.*

Three of the known species are very similar. *C. crepera* from Western Australia is known only from a single female example with unusually long antennal pectinations (4), very dark forewings with few strigulae, and partly whitish hindwings. In *C. australis* the antennae are bipectinate in both sexes, the males are smaller than the females, and the hindwings are uniformly fuscous. In *C. mesogeia* the males are larger than the females, the female antennae are simple, and the hindwings are usually more or less whitish. *C. caliginosa* may be recognised by its brown head and patagia.

70. Culama dasythrix n.sp.

δασυθριξ, densely hairy.

♂, 36 mm. Head grey-whitish. Palpi 1 and a half; whitish. Antennae dark fuscous; pectinations in male 6. Thorax grey-whitish; some fuscous suffusion anteriorly and reddish-brown centrally. Abdomen densely hairy; grey-whitish. Forewings with costa straight, apex rectangular, termen rounded, slightly oblique; grey-whitish; markings reddish-brown; a small patch of long transverse striae beneath costa near base; a roundish spot above three-fourths dorsum; a large oval subapical spot; cilia grey-whitish. Hindwings and cilia grey-whitish.

West Australia: Kelmscott near Perth in September (G. F. Berthoud); one specimen. Type in National Museum.

71. Caluma australis Wlk.

vii, p.1524.

♂, 46-52 mm. ♀, 44-75 mm. Palpi in male 1 and a half, in female 3. Antennal pectinations in male 4, in female 1 and a half to 2.

North Queensland: Gilbert R. Queensland: Yeppoon; Gogango; Caloundra; Brisbane; Toowoomba; Injune; Stanthorpe. New South Wales: Scone; Sydney; Mittagong. Victoria: Moe. Tasmania: Cradle Mt.; Hobart. West Australia: Yallingup; Dowerin; Perth.

72. Culama mesogeia Turn.

Trans. Roy. Soc. S.A. 1932, p.195.

♂, 38-62 mm. ♀, 35-42 mm. Antennal pectinations in male, 2 and a half; antennae in female simple. Palpi 2 and a half.

Queensland: Clermont; Brisbane; Toowoomba; Dalby; Injune; Carnarvon Rge.; Talwood. New South Wales: Broken Hill.

73. Culama crepera Turn.

Proc. Roy. Soc. Q. 1938, p.152.

West Australia: Coorow.

74. Culama caliginosa Wlk.

vii, p.1533.

♂, 58-68 mm. Head pale brown; face fuscous. Palpi 1; fuscous, lower surface of second joint whitish. Antennae fuscous; pectinations in male 5. Thorax grey; patagia pale brown with whitish posterior fringe. Abdomen grey, tuft whitish. Legs grey with whitish rings. Forewings elongate, suboblong, costa straight, termen slightly rounded, slightly oblique; grey with blackish and grey irregularly waved transverse lines; postmedian line furcate towards costa; cilia grey. Hindwings and cilia grey.

New South Wales: Sydney. Victoria: Moe. Tasmania: ——.

15. Gen. MACROCYTTARA Turn.

Tr. Ent. Soc. 1918, p.160.

Head with tuft of scales on crown. Palpi 2; in male ascending, thickened with appressed scales, terminal joint minute; in female more slender, porrect. Antennae in male bipectinate to apex; in female simple. Thorax with rough anterior crest. Tibial spurs well developed but short. Forewings with areole long (two-thirds), areole and median cell moderate, all veins separate, 11 from areole. Hindwings with median cell small and very narrow, upper branch of median short, joining the acutely indented angle formed by discocellulars, or absent through fusion of this branch with discocellular, 6 and 7 connate or short-stalked. Type, *M expressa.*

75. Macrocyttara expressa Luc.

Proc. Linn. Soc. N.S.W. 1902, p.246.

Queensland: Brisbane; bred in large numbers by Mr. R. Illidge from larvae tunnelling the stems of the "milky mangrove."

76. Macrocyttara pamphaea n.sp.

παμφαιος, wholly dark.

♂, 32 mm. Head, thorax, and abdomen dark fuscous. Pectus white. Palpi porrect, exceeding face; fuscous. Antennae dark fuscous; pectinations in male 2. Legs fuscous with white bars. Forewings suboblong, costa nearly straight, apex rounded, termen rounded, slightly oblique; dark fuscous with slender blackish transverse lines and strigulae; cilia fuscous, bases and apices slenderly whitish.

Queensland: Cunnamulla in October; one specimen.

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SOME GEOLOGICAL NOTES ON THE PIONEER RIVER BASIN AND ADJACENT AREAS.

By Frederick Bennett, B.Sc.

(With one map in the text.)

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INTRODUCTION.

This paper deals with the middle and lower portions of the Pioneer River basin below Nicholson's Crossing (Parish Abingdon, por. 1302) and areas adjacent to this part of the basin—and broadly includes the parishes of Hamilton, Ossa, Hampden, Bassett, Abingdon, Greenmount and Howard, all of which are subdivisions of the County of Carlisle.

PHYSIOGRAPHY.

The River basin is in the lower part determined chiefly by (1) *The Northern Divide* running S.E. from Mt. Dalyrmple to Kungurri then S. of Mt. Martin through Mt. Toby to Mt. McGregor, then turning E. by Mt. de Moleyns to The Leap, through Farleigh and the Black Mountain thence to Glenalbyn, Glenella through portion 95, parish Bassett past the head of Thornber Creek to Slade Point where it reaches the sea—then, presumably, under the sea, to Brampton Island.

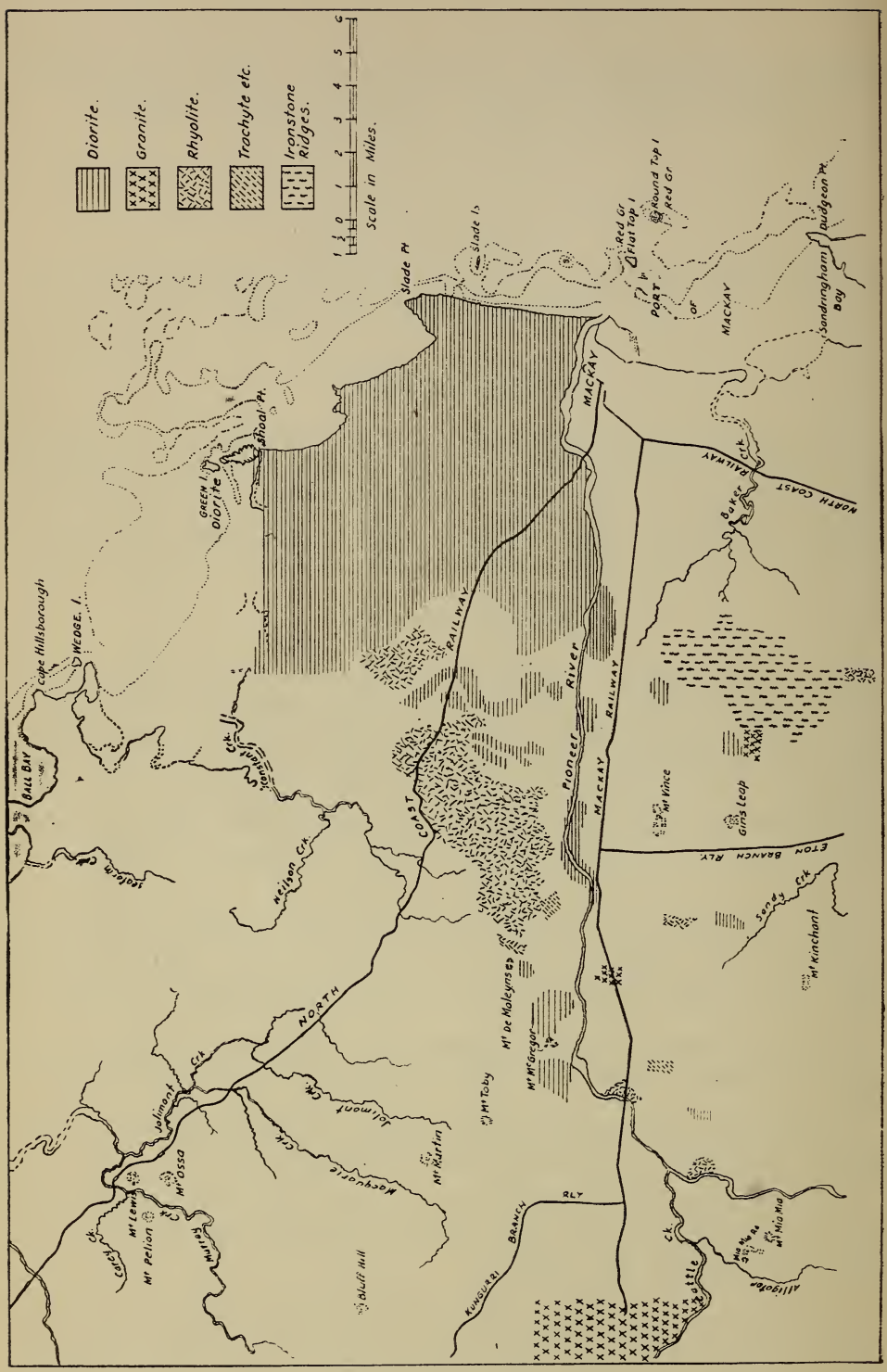
(2) On the *west* a granitic scarp from Mt. Dalyrmple S.E. to Dunwold (where a lower part to the S. lets Cattle Creek through) then by the Mia Mia Ranges S. as far as the west of por. 133, parish Mia Mia (where it joins a spur from the Clarke Range south of Boongana).

(3) An *eastern* boundary coming up from Connor's Range on the S. through Mt. Bridgman, Mt. McBryde, Ben Mohr and Blue Mountain.

A low exit point exists round Mirani; Mt. McGregor lies N.N.E., the Blue Mountain is S.E. and the Mia Mia Range lies S.W.

The determining slopes are two—a slope S.E. towards the coast between Dundulu and McEwen's Beach—the other, the steeper of the two, due E. towards Mt. Bassett.

The river therefore runs due E. from Mirani falling 171 feet in 25 miles and in consequence of this big fall there are few really big pools. The river is rapid, and, running near the base of the igneous north scarp for 25 miles, has a rocky bed as far as Dumbleton; it is only at Foulden that tidal influences come into play.



Map of the Pioneer River Basin.

The S.E. fall, however, has a noteworthy effect. The Pioneer here receives many streams from the main scarp—the N. boundary—but *not one* from the South or East.

The north branch of Sandy Creek, and Baker's Creek draw water from within a stone's throw of the very river bank and three sugar mills have happily utilised this peculiarity to dispose of their effluents without contaminating their water supply. The creeks themselves show the same peculiarity. Rocky Creek draws water from por. 104, Par. Greenmount, on the very brink of Baker's Creek.

GENERAL GEOLOGY.

The sediments of the area under discussion belong to the Bowen Series, but igneous activity subsequent to their deposition has been so intense as to obscure all but small patches of this series, this igneous activity producing first an extensive series of diorites and later rhyolites, the two types covering the greater part of the area and obscuring the underlying rocks. In addition to these two main types, others with their hypabyssal equivalents occur in the area.

As is well known, with a geological survey of this kind which involves igneous rocks an intensive survey of an area is required in order to produce a connected picture of the distribution of the various igneous types, but as this is in the nature of a reconnaissance survey it has been thought advisable to record localities of types rather than construct a pretty picture based on insufficient data, and it is to this end that the following types and their localities are discussed.

Diorites.

The diorites with, in places, andesitic tuffs form the largest and most marked part of the area.

From Black Mountain, which dominates this igneous mass, outcrops of diorite radiate in every direction—to Seaview, Green Island, Habana, Eimeo, Black's Beach, Slade Pt., Glenella, Mt. Oscar, Mt. Bassett, and as far as Brampton Islands.

In addition to this large single area, diorite masses separate Goose-pond Creek from McCready's Creek on the one hand and Fursden Creek on the other; Fursden Creek from the east branch of Nebia Creek and also the eastern and western branches of Nebia Creek.

The interesting mass of Turner's Sugarloaf (N.W. of por. 499, Par. Bassett), which is weathered felsitic material (probably a dyke), is surrounded by masses of diorite which occur on the hill to the S.E., and four smaller spurs to the S.W. Two branches to the north are dioritic; the more western of these drops considerably to form two yet smaller ridges at the head of Reliance Creek.

A dioritic mass occurs in the form of an inlier jutting up through the surrounding rhyolite in por. 757, parish of Hampden; relics of its former rhyolite cap form a scree on the lower flanks of its N.E. side. Other inliers of this nature, in each case surrounded by rhyolite, occurs at Dalrymple's Lookout (this should not be confused with Mt. Dalrymple which is many miles from this point) and at portion 648 and section 60, both in the parish of Hampden.

Quartz diorites occur at Dalrymple's Lookout, portion 11, Greenmount, also at portion 661, parish Abingdon, and the E. side of Antoney's Crossing, S.W. of portion 534, parish Abingdon. These also occur at Homebush Lookout, portion 441, parish Eton, Burgess' Quarry, portion 1464, parish Abingdon, White's Ridge, portion 1088, parish Abingdon, and (probably) Hogan's Ridge, portion 1302, parish Abingdon; also the Quarry at Newbury Junction.

Basic Tuffs.

An area from portion 1547, parish Mia Mia, past portion 989, parish Hamilton (in the river bed near H. Rowe's), at McGregor Creek Bridge, Toby Creek Bridge, The Dingle (E. of Marian), Reeves Creek Bridge, portion 1274 parish Hampden and the mouth of Two-Mile Creek—all show a friable, basic igneous tuff which is easily eroded or weathered and abounds in brecciate ejecta. These always occur with dioritic material and frequently intrusions of felspar porphyry type are associated with them. The exact relationship however could not be explained on the data available.

This felspar porphyry which has a characteristic appearance also occurs on a ridge just N.W. of Marian and on Hardwick's Ridge, E. of portion 1475, Parish Abingdon.

Rhyolites.

These rocks are best and most extensively developed in a belt up to 3 miles wide on the north-western side of a line from Mt. de Moleyns through Milton's Knob, Banaghan's Hill, The Leap and along Reliance Creek until they give place to the diorites referred to above which extend from here to the coast. S. of the river rhyolite caps the Green Knoll Quarry—of the same general type as that which is to be seen at The Leap. It also occurs in portion 641 Greenmount, E. of the Yellow waterhole, and N.E. of portion 1235 Homebush and a similar type at the Grass-tree Gold Mine N.E. of Sarina.

The cutting at The Leap and the quarry at Green Knoll especially seem to indicate the following succession—(*a*) the intrusion into the Bowen Series of the diorite, followed by (*b*) the overflowing of these rocks by several sheets of rhyolite (not necessarily contemporaneous).

Good examples of these rhyolite flows may be seen in the cuttings between The Leap Railway Station and The Leap; while the general sequence is best seen at Green Knoll Quarry. This rhyolite is frequently friable in nature.

Speaking generally the more acid types, with preponderance of rhyolites and sometimes the occurrence of granites (and their normal aplitic modifications) with which they are associated, are in evidence at Nicholson's Crossing, Mirani Bridge, the southern flanks of Mt. de Moleyns, the N. end of Reeve's Creek, Milton's Knob, Banaghan's Hill, Up. Balnagowan Creek to its head (and down its eastern side to the E. side of portion 31v parish Hampden), then from portion 1356 Hampden along to The Leap, then along to portion 483 Bassett.

From The Leap a spur of rhyolite runs S. to the S.E. of portion 496 Bassett where it approaches Turner's Sugarloaf. The rhyolite ends at the S.E. of portion 757 parish Bassett, giving place to a diorite spur which runs up past its end to Galea's scarp.

Obsidians associated with the rhyolite are to be seen in the cuttings between The Leap and The Leap Railway Station, and also on the W. side of portion 1051 parish Hampden and in the S.E. of portion 500 parish Hampden; also at Mr. Peach's home Sub. 67 parish 474 Hampden they are particularly interesting.

Granophyre? occurs at the Pleystowe Railway Station.

Aplites are found at the Quarry Hill, N.E. from Mt. Oscar and at the old Quarry at Mt. Bassett.

Trachyte.

Gibb Maitland has recorded the occurrence of trachytes at Mt. Vince, Mt. Jukes, Mt. Martin, and I would record here the occurrence of a trachy-rhyolite at Mt. Ossa.

Granites.

Grey Granite is found at Mt. Dalrymple and the Ben Mohr Spur. Other localities in which granite types occur are Kungurri, a scarp running from Mt. Dalrymple S.E. to Dunwold, Connor's Range, Mt. Bridgman, Mt. McBryde, Ben Mohr and Blue Mountain. At Flat Top Island and Round Top Island a red granite occurs. At Eton Hill quite an extensive microgranite occurs.

Sediments.

Where the sediments of the Bowen Series are to be seen they are frequently markedly indurated from the effects of the later igneous intrusions and extrusions.

Contacts of this nature occur at Pleystowe Railway Station, in the river bed at Pleystowe, at Green Knoll Quarry, New Walkerston Quarry, portion 105 parish Greenmount and on the eastern side of the stony divide between Baker's Creek water and Sandy Creek water and the Boomerang Lagoon—the eastern foot of these stony ridges producing bog iron-ore and excellent road-binding material due to seepage. Some bog iron-ore is found on the eastern side of portion 1027 parish Abingdon and on the extreme south-east of portion 474 parish Bassett.

The general attitude of the sediments of the area cannot be assessed due to (*a*) their infrequent occurrence without an igneous cover; and (*b*) where they are visible in cuttings and sections they are invariably covered with the igneous material and no dip or strike could be measured.

Notably, patches of these sediments occur in small extent west of Eimeo, in a cutting north of the Black Mountain but nearer Etowri, near Cox's, portion 474 parish Hampden and, as mentioned before, small patches at Pleystowe Mill, Pleystowe Railway Station and Green Knoll. No fossils, coal or oil of any significance have been noted.

Copper has been worked at Bentley's (Pinevale) and Bong Bong, with rumours of a small showing of copper at Cazzulino's and a poor coal at Griffith's (Two-mile Creek). Some quartz crystals have been found near Wundaru, but, speaking generally, the nature of the igneous cover does not tend to reveal metallic or mineral wealth in the Pioneer basin.

My thanks are due to many kind friends in the Mackay district, whose assistance in transport, hospitality, &c., was invaluable.

TRYON MEMORIAL LECTURE.

Henry Tryon—First Hon. Secretary, Royal Society of Queensland, and his place in Queensland Science.

By C. T. White, Government Botanist, Brisbane.

(*Read before the Royal Society of Queensland, 30th October,* 1944; *issued separately, 25th June,* 1945.)

Henry Tryon, one of the outstanding personalities of the early scientific life of Queensland and a contemporary of such well-known figures as R. L. Jack, F. M. Bailey, Jos. Bancroft and C. W. De Vis, came to this State about 1882 and obtained his first official position as an assistant at the Queensland Museum in 1883. He was born at Buckfastleigh, South Devon, England, on 20th December, 1856, and died at Brisbane on 15th November, 1943.

After a primary education at Sherwood College, he became a medical student at the London Hospital, one of his instructors being the celebrated Ray Lancaster, for whom throughout his life he had the profoundest regard. Medicine, however, apparently did not appeal to the young man as a profession and he left the hospital before completing his course and turned towards the study of natural history. Tryon was a naturalist of the old school in the sense that he was interested in all branches of natural science and had a good working knowledge of geology, insects, shells, birds, plants and general zoology. The more exact parts of the natural sciences such as taxonomy and anatomy appealed to him more than the philosophical, and thus it was that Darwinism, with all its subsequent bearing on biological science, passed him by so that he always seemed quite unaware of its very existence. An indication of his outlook on science may well be ascertained from the subject of his presidential address before the Queensland Field Naturalists' club in 1908—"Linnaeus and Buffon." It was of their type that he was a great admirer.

One of his earliest exploits in natural history soon after leaving the medical school was to travel through Sweden following the tracks of the great Linnaeus collecting plants and insects, particularly the former. This was a great joy to him, and in later years he often lived this trip over again in memory.

Later he journeyed to New Zealand managing a grazing property for his father, but here again the love of nature called him away on a lengthy collecting tour. New Zealand hills having too strong a pull for him to resist. He became friendly with Thos. Kirk and paid special attention to the botany of New Zealand. It is pleasing to know that his collections, which were extensive, have found a permanent home in the Queensland State Herbarium, from where duplicates when available have been distributed to kindred institutions. New Zealand made a strong appeal to him and he always retained pleasant memories of the time spent there, and never lost his knowledge of the Maori language. The life of a grazier made no appeal to him, and hearing of the great possibilities of the sugar industry in North Queensland and wanting to do something fresh, he decided to come to this country. He travelled a great deal over much of North Queensland looking at sugar lands, but there was one life that Tryon was destined for, and that was the pursuit of natural science. In 1883 he received his first appointment as an assistant at the Queensland Museum, then under the directorate of C. W. De Vis. After some years as Assistant Curator at the Museum, Tryon was appointed, in 1894,

as Government Entomologist in the youthful Department of Agriculture, later Department of Agriculture and Stock, and in 1901 became also Government Plant Pathologist, holding the dual position until his retirement in 1929. During these years he published many records of insect, fungus and bacterial pests in his annual reports, which were mostly of a voluminous nature. One of his earliest Departmental reports was on the insect pests of the orange orchards of the Wide Bay district published as Bulletin No. 4 (2nd series) of the Queensland Department of Agriculture in 1894. Before this, however, and while he was Assistant Curator of the Queensland Museum, he was commissioned by the Government to visit the Darling Downs and report on the diseases of orchard trees and agricultural plants. The results of this were published as a parliamentary paper under the title of "Inquiry into Diseases affecting the Fruit Trees and other Economic Plants in the Toowoomba District." The Government, however, thinking this in the words of the then Secretary for Public Lands (Mr. Hume Black) "Too valuable to be confined to the shelves of a parliamentary library," decided to publish it as a special "Report on Insect and Fungus Pests No. 1" of the Department of Agriculture. 1889.

Tryon was a man of very keen eyesight and was fond of examining everything he picked up with a high power, small-field hand lens he invariably carried. He was an expert section-cutter with the ordinary hand razor, many of his sections I well remember having the appearance of being cut with a heavy sliding microtome. He was a man of very sharp scientific intellect, but unfortunately once he had made a discovery was not inclined to tackle the drudgery of writing up his results in a carefully prepared manuscript suitable for presentation to the scientific public. Thus it was that much was never published at all and other material was presented in a form scarcely worthy of its importance. In this connection it must be recognised that Tryon during the whole of his professional life for nearly fifty years was inundated with queries; before the days of stenographers and typewriters all of these had to be answered by hand, and many of his letters were almost scientific treatises in themselves.

From his arrival in the colony (now State) to almost the day of his death Tryon took an active part in the scientific life of Brisbane. He was the first Hon. Secretary of this Society, and Vol. i. of our Proceedings contains a paper on the "Savo Megapode" of the Solomon Islands by A. H. Kissack which was communicated by Henry Tryon and a short note by Tryon himself on "A Locust Plague on the Lower Herbert." The early volumes of this Society contain several papers by Tryon, but he ceased to contribute after a time, most of his work appearing in the publications of his own Department. After a lapse of many years, on 27th September, 1926, he again read a big paper before this Society on "Queensland Fruit Flies (Trypetidae), Series I.," which was published in Vol. xxxviii. of our Proceedings. This was the last big piece of research work Tryon published. He was elected an Honorary Life Member of the Society in 1929.

It is interesting to note that this Society, largely through the efforts of its early Hon. Secretary, was able in 1888 to send H. O. Forbes, the well-known naturalist-explorer, the sum of £100 in aid of his work in New Guinea. Forbes, though a capable naturalist and well known for his work in Sumatra, Timor and some of the lesser known islands of the Malay Archipelago, had great difficulty in financing this expedition to New Guinea, and in consequence his travelling in that country was much

curtailed. A large camp was established at Sogeri and it was around about here most of his collecting was done.

Tryon was the first president and one of the founders of the Natural History Society of Queensland which was formed in 1892 and had but a short life, ending so far as I can find in 1894 or 1895. The Society published one volume of "Transactions," which contains four papers by Henry Tryon.

He apparently never took an active part in the Field Naturalists' section of our Society, which flourished about the same time. This latter from the commencement was mainly botanical, no doubt due to the activities and leadership of Frederick Manson Bailey. The first report of this section appeared in Vol. iv. of our Proceedings, 1887, and the last in Vol. x., 1894. From this date the section lapsed, and it was not until 1906 that another Field Naturalists' Society was established, the present Queensland Naturalists' Club, of which at an inaugural meeting on 6th April, 1906, Sydney B. J. Skertchly was elected President and Henry Tryon Vice-President. Tryon always took a very prominent part in the activities of this Club and in the early days organised many of the longer excursions. He was also a President of the Gould League of Bird Lovers, afterwards incorporated as a section of the Queensland Naturalists' Club under the title of the Nature Lovers' League.

Tryon was also a fairly regular attendant at meetings of the Royal Geographical Society of Australasia (Queensland Branch), but so far as I know, except on one or two occasions, took little active part in the work of the Society and never contributed anything to its journal.

In August, 1895. Tryon was appointed to visit British New Guinea (now the Territory of Papua) to collect sugar-cane varieties, which were sent to the State Nursery at Kamerunga, near Cairns, the Sugar Experiment Station, Mackay, and the Department of Agriculture in New South Wales. He had with him as assistant Mr. John Liverseed, of the Queensland Department of Agriculture, afterwards manager of the State Farm, Hermitage, near Warwick. In his work, "The Queensland Sugar Industry," Mr. H. T. Easterby, the then able Director of the Bureau of Sugar Experiment Stations, referring to this visit states: "Mr. Tryon brought back sixty-six varieties, including the well-known 'Badila,' which is considered to be the best variety ever introduced into Queensland. The sugar industry undoubtedly owes a great debt of gratitude to the Department of Agriculture for this cane, to which the successful cane-growing in the North is largely attributable. Seeing that in many of these areas 95 per cent. of the cane grown is of this variety, it is not stretching the point to say that quite a number of growers owe their success as cane-farmers to it."

Tryon had always taken a very keen interest in the biological control of insect, fungus and plant pests, and as early as 1899 had suggested the possibility of the control of prickly-pear by natural enemies. In 1903 he was instrumental in importing from India specimens of the wild Cochineal insect for trial in prickly-pear eradication in Queensland. Unfortunately, however, this importation did not succeed in the establishment of the Cochineal insect in Queensland.

In a paper published in the "Queensland Agricultural Journal" for October, 1910, he strongly recommended that the "Government prosecute inquiries in countries wherein the wild Cochineal insect or insects are indigenous, or have become naturalised on being introduced—e.g., Mexico, West Indies, Brazil, Argentina, Senegal, Cape of Good Hope,

and especially in India and Ceylon." There is no doubt, I think, that the suggestion eventually led to the appointment soon after (1912) by the Queensland Government of a travelling commission comprising T. Harvey Johnston (chairman), H. Tryon (member) and C. W. Holland (secretary) to visit the many countries where prickly-pears were indigenous or had been introduced and become naturalised, and to investigate means of control that might be applied in Australia. In "The Biological Campaign against Prickly Pear." published in 1940 under the authority of the Prickly Pear Board, A. P. Dodd, officer in charge of Scientific Investigations, stated: "The commission spent eighteen months in visiting the many countries where prickly-pears were indigenous or had become acclimatised, and in its subsequent comprehensive and most valuable report made definite recommendations for the introduction under safeguards of certain insects and diseases from America. During its travels the commission forwarded to Australia from Ceylon small stocks of the cochineals, *Dactylopius ceylonicus* and *D. greeni*; the former insect was successfully reared by Dr. Jean White-Haney at the Dulacca Experiment Station, was liberated in the field, and in the space of a few years almost completely destroyed the scattered areas of *Opuntia monacantha*. At this stage it should be mentioned that among the prickly-pear insects encountered by the travelling commission was *Cactoblastis cactorum,* larvae of which were found in the Botanic Gardens at La Plata, Argentine. Mr. Tryon actually brought some of the caterpillars alive to Brisbane, but failed to rear them through to the adult stage. Had this effort been successful, the control of prickly-pear may well have been brought about years earlier than has been the case."

His wife predeceased him by some years and the death of his elder daughter shortly before his own death was a great blow to him, as he had bought a new house and arranged for her to live with him and keep it on after his death. A son died in childhood. He is survived by a married daughter (Mrs. Hubert Jarvis) and two grandchildren.

In appearance Tryon was rather tall and of medium build—in later years inclined to be sparse; he had a pale skin and always wore during the thirty-odd years I knew him a moustache and short beard. He was a distinguished-looking man and might be described as typically English in appearance, or perhaps we should say nobody would mistake him for other than an Englishman. He was a very vigorous man, and one of his favourite pastimes was taking long walks in the bush. On these occasions he usually walked with rather a loping gait, by which he could cover many miles in a day. On most of these natural history rambles he was accompanied by friends, but many walks were taken by himself. In spite of the fact that he is primarily known as an entomologist, it always seemed to me that plants claimed his main attention on these outings. He was a very keen geologist and a life member of the Geologists' Association (Eng.). He always wore heavy suits of dark material, even in hot weather, a large black tie, and single standup collar. He had a ready wit, though his remarks were frequently on the personal side and sarcastic enough to create for him some enemies.

His interests were not confined to science, broad though they were in that sphere; but he was an omnivorous reader of history, theology, poetry, and the classics. He was a striking personality; his death left a decided blank in Queensland natural history circles, and severed a link with the earlier scientific life of the State.

A complete list of his publications was given in the "Queensland Agricultural Journal" for August, 1929 (Vol. xxxii., pp. 178-183).

A NEW CERIOIDES WITH FOLDING WINGS (Diptera-Syrphidae).

By G. H. Hardy.

(*Received* 18*th October,* 1944; *accepted for publication,* 27*th November,* 1944; *issued separately,* 25*th June,* 1945.)

Genus Cerioides Rond.

Between 1922 and 1927, Shannon divided this genus giving names that do not appear applicable to the Australian fauna. Ferguson (1926) applied three of these names, pointing out that not all characters cited by Shannon are present and there now seems to be no justification for separating *C. breviscapa* Saund. from *C. subarmata* C. & B. on characters used for the purpose; indeed they evidently form a natural group together with the new species described below. Thus only two groups can be retained to accommodate the Australian *Cerioides* until such times as the world's forms become better known. Of the twelve species hitherto described, six belong to the *breviscapa*-group, distinguished by the constriction near the base of the abdomen being excessive and wasp-like, and to this group the new species is added below. The *ornata*-group has but a slightly constricted abdomen.

Cerioides breviscapa-group.

The two species which I myself have captured in the bush, had their wings folded longitudinally when at rest, a character reported by me in 1933, and I would suggest that all species with the character belong to one natural group, but it is uncertain as to how far this extends in the group as at present understood. The character is readily overlooked as the flexure neither occurs readily when in the relaxed condition, nor is the flexure retained at death. The wing is flexed upwards, bringing the halves, rear above fore, to lie in parallel planes and not touching. Seen from above, the line of flexure shows three straight lines meeting at two points, forming two obtuse angles. This line of flexure has been traced by Mr. Edgar Riek and myself, using a freshly captured specimen of *C. subarmata,* caught by Mr. Riek on the large swamp at Sunnybank in August 1944, and this assures that on all pinned specimens with a wing folded, the feature is identical with that of the living state.

The line of flexure runs at least half way along the anterior margin of the alula, which normally is hinged to turn upwards on many flies, then passes at an angle to a deep crease just behind the median vein,

and continues along this crease through the depression at the furcation of the median vein, continuing without altering its course out of the end of the crease passing over the intervening bend of the median vein to the wing margin; this last portion shows the wing to be, not angular as at the crease, but bowed, and leaves no mark to indicate the course; and further the surface is bowed between the alula and the crease, again leaving no mark when the wing is flattened.

KEY TO SPECIES OF THE BREVISCAPA-GROUP.

1.	Wings with the normal dip in the radial vein	2
	Wings without this dip in the radial vein. Male with the short form of antennal tubercle and the long form of the second abdominal segment. Female with the long form of antennal tubercle and the short second abdominal segment ..	*alaplicata* n.sp.
2.	With the brown in the radial area covering the dip..	3
	With the brown of the wing much reduced and not entering the dip	6
3.	Antennal tubercle and second abdominal segment short in both sexes	*breviscapa* Saunders.
	Antennal tubercle long	4
4.	Face black in the median area, but a thin greyish obscure median line may divide the black area longitudinally	5
	With the median facial line yellow. Second abdominal segment long. Male not known	*fascialis* Ferguson.
5.	Second abdominal segment long; female not known ..	*subarmata* Curran & Bryan.
	Second abdominal segment short; male not known ..	*mastersi* Ferguson.
6.	Thorax with vittae. Frons pitted on female. Second abdominal segment long	*macleayi* Ferguson.
	Thorax without vittae. Frons not pitted. Second abdominal segment short. Male not known ..	*doddi* Ferguson.

Characters given in the key are taken from descriptions, as the material available for study is insufficient for a full revision. It will be noted that not only does sexual dimorphism occur within the group, but also the males of three species are unknown, as also the female of one; hence it may be considered that *subarmata* and *mastersi* are opposite sexes of the same species, but colour marks and their respective habitats differ so widely that they cannot be conspecific.

CERIOIDES BREVISCAPA Saunders.

Ceria breviscapa Saunders 1845.—*Cerioides victoria* Curran 1925.

Ferguson overlooked this synonymy and neither he nor I had seen Victorian specimens, but judged the identity from specimens found in New South Wales. As markings are liable to variation in this group, such small discrepancies as those found in the descriptions are not important enough, nor sufficient in number, to permit acceptance of more than one species. Moreover, the genus is mainly a northern one,

ten of the thirteen known species being in Queensland and only four of these ten having yet been recorded from more southern States. It seems quite unlikely, therefore, that more than one species of the group here dealt with can occur in Southern Victoria, and none are to be expected from Tasmania, this being in conformity with other genera occurring mainly in Queensland.

Ferguson comments upon the type locality "Port Phillip, South Australia" as an apparent misstatement. Nevertheless this was quite correct, and the only alternative would have been "New South Wales" which, at that time, covered the eastern half of the continent which was just beginning division into States The use of "South" referred to location in the sense of southern, not to the State of that name which was proclaimed a colony eight years earlier, 1836. Victoria, as a State, was inaugurated in 1851, six years after Saunders described this fly.

Cerioides alaplicata n. sp.

Male.—The antennal tubercle is about as long as broad, light brown in the colour, which extends a considerable distance around the base, merging into the black-brown median stripe which occupies about one-third the width of the face that is otherwise yellow. Below the yellow occurs an upward sloping line from the oral margin to the eyes, below which the colour changes to black-brown, varying in intensity of the black, to brown below and without a definite pattern, and further extends a short distance at the rear of the head, and above this the area behind the eyes is black with a slight grey pulverulent overlay. The eyes are contiguous from the ocellar tubercle to two-thirds the distance towards the antennal tubercle, where the frons is yellow as on the face with a varying but narrow median brown area, this area forming part of the brown surrounding and on the antennal tubercle. The antennae are blackish brown with the first segment about as long as the remainder.

The thorax is black and quite normal, with two pairs of yellow dorso-lateral spots and the scutellum is margined with yellow, but these yellow areas are liable to discolouration and reduction in size.

The abdomen is black-brown with the long type of second segment The apices of the second to fourth tergites are margined with yellow and these three tergites are equal in length.

The wings are quite normal in venation except that the fifth radial is only sinuous, the customary "dip" being absent. The brown of the anterior border extends over the whole radial area and also above the vena spuria from the radial median cross-vein to level with the furcation of the median vein. When at rest the wings fold as described above, and the characteristic crease that indicates the folding and lies adjacent to the median vein is present. The legs are yellow to light brown with the basal half of the femora black.

Female.—This sex differs by the antennal tubercle being about as long as the first antennal segment, four times longer than wide. The black-brown frons strongly diverges towards the antennae, averaging about one-third the head width, and is strongly corrugated over a large black area that is divided by a smooth and brownish median stripe, whilst a similar stripe lies adjacent to each eye, and a band likewise at the ocellar tubercle, all merging into the smooth brown summit. The yellow lateral spot at the transverse suture may become brown, reduced or entirely absent, and the scutellar margin may similarly become brown, as also the margins of the abdominal tergites. The second abdominal segment is of the short type, being only about as long as wide, and in general tone the female is slightly darker than the male.

Hab.—Queensland: Goondiwindi, 10 males and 13 females taken together at a flowering shrub, probably Wilga (*Geijera parviflora*) in November, 1935, and in company with two males of *C. opuntiae* Ferguson.

The name of this species reflects upon the habit of wing folding, and many of the specimens have one wing in the folded condition, care having been taken to restore and retain the position when mounting the specimens. The series will be distributed amongst various Museums and other collections.

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THE GEOLOGY OF CENTRAL AUSTRALIA.

By H. I. Jensen, D.Sc.

(*From an address delivered before the Royal Society of Queensland, 26th June,* 1944; *received for publication and accepted 28th November,* 1944; *issued separately, 29th June,* 1945.)

1. INTRODUCTION.

There is a popular mis-statement very often repeated to the effect that Australia is the oldest continent in the world. There is some biological foundation for this belief in those animal and plant survivals of mesozoic types of fauna and flora indigenous to Australia, such as marsupials, the platypus, the macrozamia, *inter alia,* but such survivals after all only indicate a condition of isolation extending back for considerable periods.

Geologically Australia consists of old lands and new lands. A considerable, in fact major, proportion of West Australia, the Northern Territory and South Australia is composed of formations belonging to the Archæan, Proterozoic and Cambrian, while newer formations dominate in the eastern States, considerable portions of the Murray Valley area being capped with Tertiary.

Central Australia contains some of the oldest geological formations in Australia, but it would be a wild, unfounded and unproved statement to assert that these formations are older than other ancient gneissic areas such as those of the Canadan shield and of Central Brazil.

Even when an enthusiastic geologist tries to bring together in point of time formations of the older proterozoic in remotely distant portions of Australia he treads on dangerous ground. Honman, for several years senior geologist of the Aerial, Geological, and Geophysical Survey in Queensland, being himself a West-Australian, assigned to various formations in the Cloncurry district the same names as similar formations had been given in Western Australia. Much as one may admire Honman's endeavour to simplify and connect up, the facts were insufficient to warrant the correlations implied. For the present it is better to use the alternative Queensland names of these formations, such as the Soldier's Cap, and Mt. Isa series, without any implication of the one being equivalent to the Warrawoona or the other to the Mosquito Creek series. The key to the correlation of the proterozoic rock of Eastern and Western Australia has to be found by the closer study of the rocks of the Northern Territory. Dr. Madigan (1931-1933), lecturer in geology at the Adelaide University, closely studied the

Macdonnell Ranges, and divided and named the formations from oldest to the Ordovician as follows:—

1. Arunta Complex, very old gneisses, etc.
2. Perta-knurra, schists and quartzites with limestone.
3. Pertatataka, quartzites and limestones.
4. Pertaoorta, Cambrian quartzites and limestones.
5. Larapintine, Ordovician quartzites, shales and marl.

The names seem an abomination (and David (1932) spells Perta- as Pata-), but nevertheless the divisions made by Dr. Madigan are useful and safe. Correlation of these formations with others in remote parts of Australia depends on extended investigations in intermediate areas.

The writer has had occasion to investigate the Lawn Hill and Territory border area in Queensland, the Woologorang and Borroloola area on the Territory side, and fairly extensive stretches north of the Plenty River and also between Anningie and Barrow Creek in Central Australia, besides having made extensive geological surveys between the Gulf of Carpentaria and Port Darwin.

Some tentative correlations will therefore be ventured in this paper, although they should be regarded mainly as a basis for future investigation.

II. THE CENTRAL AUSTRALIAN MASSIF.

The Macdonnell and Hart's Ranges taken together constitute a massif of gneissic rocks, both of igneous and sedimentary origin. Together they form an anticlinorium built up in an archæan geosyncline. In general the strata in the Hart's and contiguous Strangway Ranges dip to the north, and those in the Macdonnell Range, which lies south of the former, dip to the south. Minor rolls occur on these two general dips but it is safe to say that the limbs of the anticlinorium have an average dip north and south respectively of about 30°, and it was on that evidence that the late Sir T. W. E. David postulated a mountain range upwards to 50,000 feet high in Central Australia in pre-Cambrian times. The pre-Cambrian uplift was oval. The average strike in the Hart's and Strangway Ranges is not quite east-west but rather W.N.W.-E.S.E. However towards the western end of the Hart's Range the dips tend to become north-westerly, and towards the eastern end north-easterly.

The Macdonnell Ranges strike more nearly east-west in the portions closely examined by Madigan. That investigator (*op. cit.*) has given such an excellent and detailed account of the Macdonnell Ranges that nothing further need be said here about them.

Right in the township of Alice Springs, between the railway station and the hospital, there is a notable hill of orthogneiss (gneissic granite) called Billy-Goat Hill. Along the northern road for 55 miles north of Alice Springs all the outcrops are gneissic and mostly gneissed igneous rocks, such as gneissic porphyries, gneissic porphyrites, gneiss-amphibolite, etc. These gneissic igneous rocks appear to be the oldest group of rocks in the massif.

The Macdonnell, Hart's and Strangway Ranges, which form the massif, are extremely rough in nature. High sharp ridges, often with cliff faces on one or on both sides, steep cones and pyramids are a constant feature. Alice Springs lies at an elevation of 1,902 ft. but the nearby Macdonnell Ranges reach to 3,000 and even 4,000 ft. The plain north of the Hart's Range is also 1,900 ft. in elevation near the foothills, yet large sections of the range average over 3,000 ft. in elevation and peaks reach up to 3,600 and 3,800 ft. Nevertheless these high ranges are traversed here and there by passes of much the same elevation as the nearby plain. Such natural breaks are of structural origin, water erosion having cut gorges along fault planes or dykes.

The great Central-Australian mountain uplift was already very dissected before the earliest Cambrian strata were laid down, although, as Madigan's papers show, further uplifts took place in the Proterozoic and Cambrian in the same area.

There are two peneplains in evidence in this region, both of Tertiary age, one about 600 ft. higher than the other. The lower and more recent one is that of Alice Springs and the plains around the ranges. It is probably post-Tertiary. The older peneplain (Birt Plain peneplain) is probably Miocene or Pliocene. Both these peneplains drop in elevation in all directions from the Cental Massif. A slow uplift has been taking place in the Massif area in post-Miocene times.

The geological formations represented in the Hart's and Strangway Ranges are much the same as those represented in the Macdonnell Range.

The oldest rocks in Central Australia are known as the Arunta Complex. Rocks of this series only occur in the Hart's and Strangway Range proper, though south of the main Hart's Range (towards the White Range) where it merges into the Macdonnell Range, formations belonging to the Perta-knurra and Pertatataka enter into the mountain building.

The oldest formations of the Arunta complex are strongly metamorphosed and gneissic granites, porphyries and porphyrites, and amphibolites are represented in them. The next oldest is a series composed of metamorphosed and gneissic sedimentary rocks with intercalations of crystalline limestone. There are basic biotite-amphibole gneisses formed from basic tuffs, biotite gneisses formed from calcareous sandstones, and felspathic and quartzy gneisses formed from sandstone and grit; and apparently interbedded with these are zones of amphibolite derived from basic volcanic flows, or perhaps from sill-like intrusions,

or both. The latest formations in the Arunta complex, within the Hart's Range, lying in a few places unconformably on the gneiss series, consist of quartzites, slates and schists. There is reason to believe that this formation is composed of remnants of the Perta-knurra series.

North of the Plenty River and fringing the boundary of the Arunta Complex there are areas and ranges built up of schists, quartzites and arkoses and slates, highly inclined and often vertically bedded. These belong to the Perta-knurra Series of Madigan. They were strongly folded up against the older massif of Aruntan rocks. The same series is noted in the Anningie Ranges west of Barrow Creek, consisting here of hematite-mica-schist, and quartzite. This series (Madigan's Perta-knurra) is probably identical with the Mosquito Creek Series recorded in other parts of the Territory and Western Australia.

Both the Arunta Complex and the rocks of the Perta-Knurra Series are traversed by abundant amphibolite and pegmatite dykes. The later series are not affected by them. It is therefore obvious that at the end of the Pertaknurra (or Mosquito Creek) period there were great igneous intrusions accompanying the folding of the rocks of that period. In the Anningie area pegmatitic and gabbroic amphibolite dykes appear as complementary dykes. Outcrops of granite of this period show up in the Huckitta area and Tower Rock area north of the Plenty River.

It would take too much space to recapitulate Madigan's work in the Macdonnells. It is sufficient to remark that the formations north of the Hart's and Strangway Ranges are, with minor modifications, much the same as those south of the Macdonnell Ranges.

The Plenty River rises in the western portion of the Hart's Range and sweeps in an arc about 10 to 20 miles north of that range easterly and then south past the east end of the Hart's Range towards the Simpson Desert. Both south and north of the east-flowing part of this river there are table hills taken to be residuals of the Cambrian. These hills show only low dips. North of the Plenty River the Arunta Complex is frequently fringed by the Pertaknurra or Mosquito Creek Series, steeply dipping and highly metamorphosed quartzites and hematite and mica schists. Overlapping these, and only low-dipping, there is an extensive series of quartzites with some rhyolitic and basaltic rocks interbedded, but containing no quartz reefs or pegmatite dykes. There are fault zones in these with the fault breccia chalcedonic. Overlying these and dipping at similar low angles and seemingly conformable to the previous there are extensive areas of quartzite and limestone which are regarded as Cambrian, as Cambrian fossils have been obtained in them in places. The conformable flat series under the Cambrian has been regarded as the Pertatataka by Madigan, and the occurrence of volcanic rocks in the series brings about a close similarity to the Nullagine.

That raises the question "What is the Nullagine"? Wide areas in the Northern Territory and Western Australia have been assigned to the Nullagine, which series is usually found to consist of interbedded sandstones, conglomerates, slaty-shales, and limestones with intercalations of volcanic rock, trachyte, andesite, dacite, basalt, etc.

David in "Explanatory Notes" stated that the Cambrian in Australia was remarkably free from volcanic action and igneous intrusions. That appeared to be true for the areas studied by him. If that statement is capable of general substantiation the limestone quartzite series carrying interbedded lavas in north-west Queensland, the Northern Territory, Central Australia and Western Australia must all be regarded as Nullagine. The more deep-seated intrusions which caused mineralisation in the series must also have been Nullagine. Thus the Wollogorang copper-field, the Maranboy tinfield, the Macarthur River silverlead deposits, and possibly the Hatch's Creek wolfram field, and perhaps also the Tennants Creek gold-field and many other Territory fields could be regarded as Nullagine mineral deposits.

Now there is no stratigraphical break between the so-called Nullagine and the Cambrian in most of the areas investigated by the writer.

Wade in his long traverse of Northern Australia from the Kimberleys to the Gulf of Carpentaria came to the conclusion that much of the so-called Nullagine was Lower Cambrian. He regarded the strong stratigraphical break between the highly folded metamorphic rocks and the gently rolling quartzite-limestone series as the base of the Lower Cambrian, whether fossils occurred in the rocks overlying the unconformity or not. Thus the Antrim basalts, which David placed in the Nullagine, according to Wade lie between the lower and Middle Cambrian. The Edith River volcanics occupy practically the same horizon.

The writer agrees absolutely with Wade's viewpoint. The andesitic and rhyolitic volcanic rocks in the Wollogorang copper-field seem on all known stratigraphical evidence to occupy a horizon in the Lower Cambrian. Tuffy horizons occur in the Cambrian Barkly Tableland series between Anthony's lagoon and Macarthur Station. The writer found a long wide diorite dyke penetrating a limestone-quartzite series near Macdonald Downs Station, north of the Plenty River; the invaded rocks were regarded by Madigan as well as by the writer as Cambrian both on lithological and nearby fossil evidence. Moreover, rocks of an entirely Cambrian facies carry copper lodes on Yah-Yah Creek; some miles from Macarthur Station; the Wollogorang copper deposits, disseminated deposits, and the silver-lead and copper bearing reefs near the Nicholson River on the Border are in what appear typical Cambrian formations; and Cambrian limestones contain abundant nodules of native copper near Delamere and Willaroo Stations in the Territory.

Evidence collected on the Lawn Hill field (N.Q.) indicated that a granite intrusion at a depth, and not showing on the surface, had uplifted the area forming a number of domes. The lower or Lawn Hill Series, which may well on existing evidence be regarded as Lower Cambrian, was greatly affected by the intrusion, and the upper, Constance Range Series only slightly, as though by expansion through crystallisation of the intrusive rock below. The Lawn Hill Series is traversed by quartz reefs many of which contain rich lead deposits.

The break in the Cambrian during which volcanic and intrusive action took place corresponds well to the break in the Templeton Series in the Cloncurry district.

On present evidence the Nullagine is a geological scrapheap which will have to be cut out or reduced. Much of it will as investigation proceeds be found to be Lower Cambrian. The Adelaide Series, the lower part of which David placed as equivalent to the Nullagine, is undoubtedly Proterozoic and pre-Cambrian. The great glacial period was late Proterozoic and anteceded *Archaeocyathinae.*

Evidence of glacial action of Pre-Cambrian age occurred as far north as Borroloola. Cores from bores put down in 1912, and outcrops of intercalated fine sandstone and shale in the Macarthur River gorge, showed periglacial involutions similar to those described from North Eastern Illinois by Robert P. Sharpe in J. Geol. 1, No. 2, Feb-March, 1942. The beds in which these periglacial involutions occur are moderately folded and underlie the more gently dipping Cambrian rocks of the Barkly Tableland unconformably.

Along the Northern Road Telegraph Line from Alice Springs rocks of the Arunta Complex only are seen in outcrop for the first 70 miles. A small range, called the Hann Range, through which the road runs before reaching Aileron, and its westerly continuation, the Reaphook Hills, consist of red quartzites dipping north at 20°, with some reddish shingly or slaty rock intercalated.

These rocks are heavily faulted. They appear to belong to the Adelaide Series. A few miles further north at Aileron rocks of the Arunta Complex again appear. Beyond Aileron there are more low gently dipping sandstone ranges, the Reynolds Range, and these too probably belong to the Adelaide Series. North of these towards Teatree, which is about 110 miles from Alice Springs, extensive areas are capped with volcanic rocks—andesite, trachyte and tuffs of these. At Teatree these rocks have been intruded by a laccolite of blue granite. Silver ore is said to occur in kaolinised tuff in hills north-east of Teatree. Northwest of Teatree there is a group of high rounded treeless hills and some spurs with cliff escarpments forming the Central Mt. Stuart group. These hills have a remarkable physiographic resemblance to Lawn Hills and have a similar dissected dome structure, and in the valley between the peripheral hills there outcrops a laccolitic mass of porphyritic felspar granite. This granite is in character very like that on the Queensland border north of the Nicholson River. Some of the Central Mt. Stuart

hills are traversed by large quartz reefs while others of exactly the same formation have not been invaded by quartz, in which respect also the hills resemble the Lawn Hills.

East of Central Mt. Stuart the road crosses some low hills called the Stirling Hills. The rock outcropping on these hills is thinly interlaminated, coarser and finer red sandstone (dipping very gently north), which appears to be of glacial origin. In the valley north of these hills there are basalts, andesites and rhyolites, tentatively assigned to the Nullagine. Further north at Barrow Creek faulting again brings the Arunta Complex to the surface, and north of a narrow east-west horst of Aruntan rocks there is a large intrusion of porphyritic dark granite. This is followed further north by more formations of volcanic nature, a mass of rocks of Mosquito Creek formation on Neutral Downs, and another mass of Mosquito Creek rock further west at the Anningie tinfield.

Several other ranges further north consist of quartzites and schists probably of Mosquito Creek age, but no rocks of a Cambrian limestone facies were seen along the Northern Road, south of Wauchope Creek.

The Cambrian sedimentary rocks are probably much more extensive in the Eastern half of Central Australia than in the western half. In the eastern half they extended with interruptions from the Plenty River to Lawn Hill. In the Western half the volcanic rocks of andesitic and trachytic nature are very widespread, and though they are at present regarded as Nullagine they may be Lower Cambrian. They are said to dominate over most of the country between Teatree and the Granites. The writer has not personally been beyond Anningie from the Alice Springs end, nor beyond Tanami from the Darwin end.

The volcanics in the Anningie area north-west of Teatree show a strong tendency to laterisation and kaolinisation with subsequent dissection of the laterites. This appears to be the result of a wet climate in the Pliocene or thereabout.

The only extensively developed rock series later than the Cambrian in Central Australia is the Ordovician Larapintine System consisting of gently folded to flat calcareous sandstones, shales and marls. They contain no dykes or intrusions whatever, according to experience up to the present.

There are small pockets of late Tertiary rocks in many places, and large areas capped often to a depth of up to 600 ft. with wind-blown sand. The valleys now filled with these quaternary sand deposits were probably carved in the moister Pliocene period.

III. MINERAL DEPOSITS IN CENTRAL AUSTRALIA.

Central Australia is not rich in economic minerals, at least not the easily accessible parts.

South of the Macdonnell Ranges at Rumbellara there are ochre deposits worked. In the Hart's Range and in the Strangway Range there are numerous muscovite deposits and at least one large phlogopite deposit. The commercial muscovite always occurs in lenticular mica-rich shoots or bunches in pegmatite dykes. The phlogopite mica is in the main occurrence developed in an ultrabasic dyke which has differentiated into an olivine rock in the centre (dunite) and augite-enstalite rocks on the two walls. Each of the three sections is 30 ft. or more in width, and the phlogopite occurs along veins in the olivine rock. Potassic solutions from the later pegmatite dykes have played a part in producing the phlogopite. This occurrence is in the Strangway Range.

Phlogopite in small uncommercial books occurs in several other localities, *e.g.*, in basic dykes in the Hart's Range and in limestone as well as gabbro at the large apatite deposit 90 miles from Alice Springs on the Hart's Range Road. The apatite occurrence mentioned is one of great dimensions and excellent purity. It is produced as a pneumatolytic emanation from a large basic intrusion and largely replaces Aruntan crystalline limestone. Garnets are very abundant in numerous formations in the Hart's and Macdonnell Ranges, and they are most plentifully and perfectly developed in certain amphibolite zones. Though ruby and sapphire should occur in the Central Australian massif, it is doubtful if any have yet been found. The Macdonnell Range "ruby" is mostly garnet.

There is in the Hart's Range an asbestos occurrence of some magnitude, and in the plains north of the Plenty River there are large kaolin deposits fringing the Aruntan rocks. In Mount Strangway there are large developments of kyanite rock accompanied by staurolite. However all these minerals are so low-priced that it does not pay to mine any except the mica.

Beryl occurs in the pegmatite dykes but is subordinate in amount.

In addition to mica, wolfram, tin and tantalite are pegmatite minerals; but as these minerals hug the contacts of the large granite masses and as the granites from which the pegmatite dykes are offshoots are deeply buried under the Hart's and Strangway Ranges these minerals do not occur in that area, but do make their appearance in both Aruntan and Mosquito Creek rocks where intrusive granites occur nearby. Thus wolfram occurs in an aplite-pegmatite dyke north of the Plenty River and also in a similar rock about 10 miles north-west of Barrow Creek, the dykes in each case intruding Arunta Complex. Tin occurs with tantalite in aplite-pegmatite dykes at Anningie intruding Mosquito Creek rocks.

In the Jervois Range, which the writer has not visited, about 300 miles north-east of Alice Springs, there are great silver-lead and copper deposits in fissure lodes in rocks which correspond to the Mosquito Creek Series, and at the Home of Bullion Mine about the same distance north of Alice Springs there are large copper lodes. But it does not pay to work these metals at present. Smaller copper lodes also occur about 80 miles north-east of Alice Springs in limestone of the Arunta Complex.

All the above minerals were introduced by the igneous intrusions which succeeded the deposition and folding of the Perta-knurra and Mosquito Creek sediments. Apart from mica and specially rich deposits of tin, tantalite and wolfram, the only profitably worked mineral is gold. The Tennants Creek field has come to stay. There is gold at the Granites and at Tanami, and there is a vast area of country north-west of Barrow Creek towards Tanami which may yet produce many good goldfields. Owing to surface water being absent except in the heaviest of rains this area is difficult to prospect, and has not been properly prospected. In this area there are many laccolitic granite intrusions which belong to the Nullagine, or more likely early Cambrian period. These granites introduced copper, silver-lead and gold in places (as they have done north-east of Barrow Creek, at Wollogorang, Lawn Hill, etc., near the Queensland border). As disseminated copper and lead ores occur in connection with this last igneous period, the evidence of ore deposits is obscure unless very careful search is made.

There is a vast amount of geological work and work on ore deposits yet to be done in the Territory.

IV. THE WATER PROBLEM.

Central Australia is almost devoid of permanent waters, hence there is everywhere need for more bores. Unfortunately there are no artesian or even subartesian basins in this part of the Territory. Subartesian waters are more generally found about 400 miles north of Alice Springs in the extensive Cambrian belt of the Barkly Tableland and near the South Australian border also in the Cambrian. The vast intermediate area only carries water in odd small localised pockets, or in fault zones. Pegmatite dykes often serve to dam back and hold moderate quantities of water in fractures in the Aruntan rocks in the Hart's Range.

During the last couple of years a vast amount of water drilling has been carried out by the army and Allied Works Council, sometimes without competent geological advice; hence failures have been numerous. The choice of bore sites is a task which can only be satisfactorily carried out by a competent geologist.

Alice Springs is unique in Central Australia in having a large underground water supply. An eroded valley between the Macdonnell Range and Birt Upland Plain has been deeply silted up with sand and its outlet must have been partly blocked by land-slip. Consequently the floods of the Todd River and branches charge these sands with water, which can stand being drawn on heavily.

V. THE SOILS.

The ranges and hills in Central Australia have little soil and little vegetation. Between the ranges there are large plain areas in which bores in search of water have often gone 600 to 700 ft. before meeting with rock. The soils are windblown mostly,—a kind of loess. They are

usually reddish in colour. If water were available for irrigation they would be highly productive, for the nature of their origin, viz., wind-blown detritus from all kinds of formations, ensures that they are rich in all mineral plant foods.

At Alice Springs, with irrigation, magnificent citrus fruit and grapes are grown, and excellent vegetables can be produced wherever water is available.

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OSTRACODS FROM SOME QUEENSLAND TERTIARY BASINS, AND THEIR BEARING ON THE CORRELATION OF THE STRATA.

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(With Plate VI. and one text-figure.)

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SUMMARY.

This paper indicates the present and the potential value of the Ostracoda in Queensland Tertiary stratigraphy. The ostracods contained in samples from eight boreholes in The Narrows Tertiary basin are described, and shown to be of value in enabling a zonation and approximate correlation of the strata to be drawn up. Ostracods from the Petrie Series and the Baffle Creek Tertiaries are also described, and the faunas compared with those of The Narrows Tertiaries and the Redbank Plains Series. As the result of this work, a probable Miocene age is suggested for both The Narrows Tertiaries and the Petrie Series, and a probable Oligocene age for the Baffle Creek Tertiaries and the Redbank Plains Series. The environmental conditions of deposition and origin of the ostracod-bearing shales in these basins, together with other related data, are discussed.

PART I.—INTRODUCTION.

Introductory and Historical.

The most abundant of the microfossils that have been found in the Tertiary shales of Queensland are the Ostracoda. They are sometimes so abundant, and other fossils are so rare, that a palaeontological study of the strata is virtually a study of the contained ostracods.

Although ostracods have been recorded from seven of the Tertiary basins in the eastern part of Queensland, very little attention has been given to their systematic study in the past.

The first reference to the occurrence of these small crustaceans in Queensland was made early in the year 1914, when Ball (1914a, p. 21) recorded "great numbers of minute, flattened oval bodies" which he regarded "as the remains of ostracods" in the oil shales of the Baffle Creek Tertiaries between Bundaberg and Gladstone. Shortly after this, he (1914b, p. 73) also recorded "minute, reniform bodies—between $\frac{1}{200}$ and $\frac{1}{10}$ in. in length—showing in vast numbers on the bedding planes of some of the shales" of The Narrows Tertiaries between Gladstone and Rockhampton, and stated that "they were much like the ostracod *Cypris.*" In 1916 Ball (1916a, p. 15), reporting on the Lowmead No. 1 Bore in the Baffle Creek Tertiaries, again referred to "the small, white, reniform bodies so characteristic of the shales, and especially of the oil shales" as ostracods. He mentioned that they were "seldom more than $\frac{1}{30}$ in. in diameter, and were enveloped by a thin, unsculptured, but cracked coat of a bluish-white, brittle, opalescent substance, which was found on chemical analysis to consist of carbonate of lime." Later in the same year, Ball (1916b, p. 213) recorded from the Nagoorin Series, near Many Peaks, an "exposure of oil shales on Ubobo Creek, identical with those met in sinking and boring at Lowmead, even to the contained Entomostraca." In 1924 Jensen (p. 287), reporting on the progress of the Australian Oil Corporation's bore on Dunn's farm near Beaudesert, 40 miles south of Brisbane, stated that "the shales from 140 ft. to 180 ft. contained abundant ostracod remains, especially from 160 ft." Subsequently Ball (1924, p. 364) referred to these Tertiary ostracods and stated that "they are massed to the extinction of their individual outlines along some of the bedding planes, the proportion of ostracod to the total bulk of the shale reaching sometimes as much as 10 per cent., where several such crowded planes occur together." In 1927 Jones (p. 38) recorded fossil ostracods from the Redbank Plains Series, in bituminous shales on portions 118, 119, and 120, parish of Bundamba, about 12 miles south-west of Brisbane, and described them as "numerous small oval bodies." In 1932 David (Table I.) recorded "ostracod and sporangia shales" from the Duaringa Tertiaries, between Rockhampton and Emerald. Ostracods have also been recorded from several places in the Petrie Series, north of Brisbane. In 1932, Ball (p. 384) discovered numerous small "flattened kidney-shaped bodies which Whitehouse identified as an ostracod allied to the genus *Cypris,*" in fissile, low-grade oil shales on the spoil heap of Simpson's well, in portion 186, parish of Nundah, about one mile E.S.E. of Bald Hills. Finally, the present writer (1944) has recorded ostracods from Brecknell's bore on portion 222, parish of Warner, north-west of Strathpine, from portion 190, parish of Warner, some two miles west of Strathpine, and from Houghton's bore on portion 24, parish of Warner, about one-quarter of a mile north of Lawnton, stating that "in some cases the bedding planes of the shales are so packed with white, chitino-calcareous, carapace valves that other material is almost excluded."

Only one short paper dealing with the systematic description and identification of any of these ostracods has so far been published—namely, Chapman's "Report on Samples of Surface Tertiary Rocks and a Bore Sample containing Ostracoda from Queensland" (1935, pp.

66-71). In that paper Chapman described the ostracods contained in a small collection of samples from the Redbank Plains Series, the Australian Oil Corporation's No. 2 Bore on Dunn's Farm near Beaudesert, and the Lowmead No. 1 Bore in the Baffle Creek Tertiaries. He briefly described two new freshwater species, *Erpetocypris aequalis* and *Cypridopsis compressa,* and identified a third as the well-known estuarine and marine species *Cythere crispata* from the Redbank Plains Series. He also described a new species (*?*) *Cythere queenslandiae* and recorded *Krithe* cf. *reniformis* (Brady) from the Beaudesert Tertiaries, and stated (1935, p. 67) that although the Lowmead ostracods were too crushed to describe in detail, they were "apparently referable to the genera *Pontocypris, Cythere,* and *Paradoxostoma.*" On the evidence of the associated freshwater and estuarine or marine ostracods Chapman concluded that the Redbank Plains basin was a lacustrine area open intermittently to a shallow sea, that the Beaudesert Tertiaries were of shallow marine or estuarine origin, and that the Lowmead ostracods indicated a shallow-water marine deposit. Both Reid and Richards (1935, p. xiv), discussing this paper, however, have said that "field evidence could not support marine incursions of these basins." With reference to the age of these Tertiaries, Chapman (1935, p. 70) stated that although "the Ostracoda give no very decisive data as to the age of the various beds other than Tertiary, the rocks may range from Lower Miocene, or even older, to Pliocene." Apart from the above paper, Chapman (in Ball, 1932, p. 384) has briefly reported on the ostracods from Simpson's well near Bald Hills in the Petrie Series, stating that "their generic affinity is very obscure, and that they can be referred to as (?) Cyprids only." The present writer (1944) has also referred to the presence of *Erpetocypris aequalis* Chapman along with other ostracods in the Petrie Series.

Thus, although the Queensland Tertiary fauna is rich in ostracod remains, it is apparent that the detailed palaeontological study and identification of these small crustaceans is almost a virgin field.

The Value and Limitations of the Queensland Tertiary Ostracods.

Since the birth of the utilitarian science of micropalaeontology some twenty-five years ago, work on fossil ostracods has increased considerably in certain parts of the world. This has mainly been due to the importance of these small crustaceans in economic geology as it has been realised that they can be satisfactorily used for purposes of subsurface correlation. However, as most of this work has been directly connected with petroleum geology, it is not surprising to find that almost all taxonomic work has been carried out on marine and estuarine forms. This is unfortunate, for, while a large and comprehensive literature on marine ostracods has been assembled, very little work has been published in recent years on freshwater members of this order. In fact, the paucity of literature and previous work on Tertiary freshwater ostracods is at present a very real handicap, and involves a consequent diminution in the stratigraphical value of systematic palaeontological work.

A number of factors contribute to the utilitarian value of Queensland Tertiary ostracods.

Although plants, freshwater molluscs, fish, and insect remains have been found in these freshwater Tertiaries, boring operations in several of the basins have shown that fossil ostracods are often almost the only.

if not the only, animal remains in quite considerable thicknesses of the deposits. In such cases they may be of value in determining the age of the strata, as well as in enabling stratigraphical correlations to be made.

They are valuable also, since their small size enables them to escape destruction in the drilling operations which are essential for the adequate study of these Tertiary basins, owing to the limited nature and sporadic occurrence of outcrops.

Moreover, although most of the ostracod valves are badly crushed, careful examination usually reveals well-preserved individuals with distinctive shape and ornamentation, so that more certain specific identifications can sometimes be made than is the case with other fossils.

Another important factor is that some of the species have been found to be moderately short-ranged and, with the recognition of charcteristic faunal assemblages, the ostracods, accordingly, may be suitable for zonal correlation purposes within a basin. It must be admitted, however, that some of the simple, smooth-shelled ostracods are definitely long-ranged and consequently of little value for purposes of subsurface correlation.

Owing to their wide geographical distribution, the ostracods have also shown themselves to be of value in indicating the stratigraphical relations of some of the different Tertiary basins.

Taxonomic work on some of the ostracods, besides being of value for purposes of age determination of the strata, is also helpful in throwing light on the environmental conditions of deposition of the sediments. For instance, the referring of species found in bituminous shales to present-day genera which are known to frequent lake floors, creeping in the mud and feeding largely on algal material is suggestive, since this is the environment in which bituminous shales are actually formed. The presence of these ostracods then can be taken as an index to such conditions of deposition.

Finally, the fact that other Tertiary fossils, apart from the fossil fish, are at present of little use for stratigraphical purposes, makes the ostracods all the more valuable as fossils.

Opposed to these advantages there are certain disadvantages that limit the satisfactory utilisation of Queensland Tertiary ostracods.

The minute size of ostracods renders their use in the field practically negligible, since accurate identification can only be determined with the aid of a microscope.

Although they may be very abundant, the valves are usually very much crushed and broken, and this makes detailed work slow and difficult, since a prolonged search is needed to find material suitable for identification or accurate taxonomic description. This is particularly the case with the Cypridae, the members of which have thin, fragile shells, which are seldom met united, as they were only held together by ligaments in life.

The assignment of the various ostracod species to their correct genera, also, is often a difficult task. This is due to the fact that the genera to which the Queensland Tertiary species are referable were originally described by zoologists and not by palaeontologists. The classification of recent Ostracoda is based principally on anatomical modifications and zoologists, while describing these with great care, have

given only unsatisfactory accounts of the structure of the carapace valves. In the case of fossil specimens, the shell is all that remains, and it is on the basis of its structures alone that the palaeontologist must make his determinations. Unfortunately, it is a fact that several ostracods with shells having essentially the same outline and surface characters have been described by zoologists as distinct genera.

A final disadvantage is the fact that, although the ostracod faunas appear to bear a general resemblance to the present-day one, little work has yet been carried out on the recent freshwater ostracods of Queensland. Accordingly, it is impossible at present to make any definite comparisons with the existing forms, quite apart from the fact that an element of doubt will always remain in such comparisons.

In spite of the above limitations, however, the Queensland Tertiary ostracods are definitely valuable. In fact, after the Foraminifera, the Ostrocoda are now recognised throughout the world as the next most economically important group of microfossils found in sedimentary rocks.

PART II.—SYSTEMATIC DESCRIPTIONS.

In the following systematic descriptions Rupert Jones' rule has been followed, where conclusive evidence is lacking, in regarding the thicker, or blunter, end of the carapace as the posterior extremity. Since the generic diagnoses are not readily available, they have been included.

Order **OSTRACODA** Latreille.

Suborder **Podocopa** Sars.

Family CYPRIDAE Baird, 1846.

Genus Cypris Müller, 1785.

Genotype: Cypris pubera Müller, 1785, p. 56.

Diagnosis: Carapace in lateral view reniform to oval. Dorsal margin variously arched. Ventral margin often sinuate, central portion usually somewhat incurved. Valves subequal, left valve usually the larger. Hinge edentulous, somewhat thickened, occupying about one-third dorsal margin. Surface of valves smooth to slightly uneven, often punctate.

Range: Jurassic to Recent, mainly Tertiary to Recent.

Cypris munduranensis, sp. nov. Plate VI, figs. 1 a, b.

Holotype: F. 1976, Queensland Geological Survey Collection. Locality: Bore 4, at 170 feet. Parish of Targinie, County of Deas Thompson, between Gladstone and Rockhampton, Queensland. Geological Horizon: The Narrows Tertiaries.

Description: Carapace small, in lateral view elongate-ovate to subreniform, highest slightly behind middle. Height slightly greater than one-half of length. Dorsal margin gently arched. Ventral margin nearly straight to slightly concave in median region. Anterior extremity somewhat obliquely rounded. Posterior extremity more broadly and evenly rounded. Valves moderately strongly convex. Convexity nearly uniform, but rising rather more steeply from ventral margin than from dorsal, and regularity interrupted by shallow transverse sulcus, crossing

valve obliquely, generally from in front of middle of ventral to behind middle of dorsal margin, and somewhat deeper dorsally. Position of greatest thickness of carapace located posteriorly, slightly behind middle. Left valve the larger, slightly overlapping right along ventral margin and the two extremities. Hinge somewhat thickened, occupying approximately central third of dorsal margin. In profile acute-ovate, with transverse sulcus showing in median region, and with posterior extremity slightly inflated. In end view oval and tumid. Surface of valves entirely covered with minute, irregularly-arranged, rather inconspicuous tubercles, and shell pierced at intervals with minute punctations—normal pore canals. Four subcentral muscle scars conspicuous, set in deepest part of transverse sulcus, generally closer to dorsal margin of shell, arranged in row sloping dorsally and posteriorly, and often contiguous or nearly so. Two central muscle scars larger and more elongate than lateral scars. Shell thin, fragile, chitino-calcareous, and transparent to translucent.

Dimensions of holotype: Length, 0.52 mm.; height, 0.27 mm.; approximate thickness of carapace, 0.3 mm.

Remarks: Cypris munduranensis does not closely resemble any of the described fossil forms of the well-known freshwater genus *Cypris* which today is so abundant in many stagnant pools. The carapace, however, is rather similar in structure to that of a recent, but as yet undescribed, freshwater species that has been collected from ponds and lagoons in S.E. Queensland. It also shows some general resemblance to the common species, *Cypris gibba* Ramdohr, which ranges from Oligocene to Recent.

This is the most abundant species in The Narrows bore-core samples examined and, owing to its small size, a large number of undamaged valves and some complete carapaces were available for detailed study. In fact, the ostracod fauna in some of the samples from The Narrows is almost restricted to innumerable individuals of this species, and it has also been found to be common in the Petrie Series material examined. The specific description, accordingly, is based on a large number of specimens. The outstanding characteristics are the obliquely-sloping transverse sulcus containing the four muscle scars, the small size, and the rather inconspicuous tuberculate and finely punctate ornament—the tubercles under high magnification being seen as small, round, somewhat flattened prominences surrounded by shallow grooves, and each approximately 0.02 mm. in diameter. The variation within the species is not great, the most noticeable feature being in the relative position of the shallow transverse sulcus on the valves. While in most individuals this crosses the valves almost medianly, in some it is located closer to the anterior extremity, and in others closer to the posterior extremity of the valve. In such cases the position of the muscle scars on the valve also varies accordingly. However, after making allowances for apparent variations due to different degrees of crushing, the shape of all mature individuals of this species has been found to be nearly constant. Also, while some very minute and immature forms occur, the size of most individuals approximates to the dimensions given above for the holotype of the species. In some individuals the shell is thin and horny, but in others it is quite calcareous and much more solid. The species has been named after the important locality name of Munduran within The Narrows Tertiary Basin, where it was first found.

Localities and Age: In The Narrows Tertiaries: Bores 1, 3, 4, 5, 6, 12, 13, 14 (see species occurrence charts), parishes of Targinie and Rundle, county of Deas Thompson, between Gladstone and Rockhampton. This species has a proved vertical range of 198 feet, and its actual range may be considerably greater. *In the Petrie Series:* Brecknell's Bore at somewhere between 60 and 178 feet, subdivision 10 of portion 222, parish of Warner, county of Stanley, near Strathpine, between Brisbane and Petrie; Houghton's Bore, at about 45 feet, portion 24, parish of Warner, near Lawnton; from Simpson's well, portion 186, parish of Nundah, county of Stanley, near Bald Hills, between Brisbane and Petrie. Probably Miocene.

Genus CYPRINOTUS Brady, 1886.

Genotype: Cyprinotus cingalensis Brady, 1886, p. 301.

Diagnosis: Carapace in lateral view oval to broadly reniform, highest generally at about, or slightly behind, middle. Height considerably greater than one-half of length. Dorsal margin strongly arched. Ventral margin almost straight. Carapace valves rather compressed. Valves unequal, left overlapping right anteriorly, posteriorly, and usually ventrally, and right sometimes overlapping left dorsally. Free edges of left valve smooth, with chitinous border broader anteriorly and posteriorly than ventrally. Inner margin of right valve thickly tuberculate.

Range: No Tertiary representative of this recent freshwater genus appears to have been recorded previously.

CYPRINOTUS PUNCTATUS, sp. nov. Plate VI, figs. 4 a, b.

Holotype: F. 1978, Queensland Geological Survey Collection. Locality: Bore 1, at 157 feet. Parish of Rundle, County of Deas Thompson, Queensland. Geological Horizon: The Narrows Tertiaries.

Description: Carapace large, in lateral view ovate to broadly subreniform, highest slightly behind middle. Height approximately equal to two-thirds of length. Dorsal margin strongly arched, sloping more abruptly anteriorly than posteriorly. Ventral margin almost straight to slightly concave in median region. Anterior extremity broadly but rather obliquely rounded. Posterior extremity broadly and more bluntly rounded. Valves moderately convex to rather compressed. Convexity regular. Valves unequal, left overlapping right along ventral margin and two extremities. In profile narrow oblong-ovate, with anterior extremity somewhat more pointed than posterior, and greatest width slightly behind middle. Surface of valves polished, smooth except for numerous minute punctations representing closely-spaced normal pore canals. Marginal zone developed along ventral margin and two extremities. Line of concrescence coinciding with inner margin, and running generally parallel to outer margin of shell. Marginal zone strongly chitinised and transparent, ranging in width to 0.1 mm., pierced by numerous radial pore canals opening internally along line of concrescence, externally near outer margin of shell. Radial pore canals closely spaced, about 0.01 to 0.02 mm. apart, sometimes in two or more series, long and short alternating, unbranched, narrow, each with bulbous enlargement near middle or between middle and outer margin. Shell thin to thick, chitino-calcareous, and transparent to opaque.

Dimensions of holotype: Length, 2·15 mm.; height, 1·46 mm.; approximate thickness of carapace, 0·8 mm.

Remarks: The high, compressed shell of this ostracod is characteristic of the genus *Cyprinotus*. In outline it closely resembles *Cyprinotus dentato-marginatus* (Baird), which has been recorded by Sars (1889) from lagoons near Rockhampton. It differs from this recent species, however, in having the shell much more closely punctate, the valves slightly higher and nearly twice as large, and in the presence of the well-defined marginal zone pierced by numerous radial pore canals. It might be mentioned here that two species of *Cyprinotus* found in Australia today attain a length of over 2 mm.

Although this species is not uncommon in some of the samples from The Narrows, owing to its large size and the subsequent crushing of the material, very few undamaged valves have been found. It has been possible in some cases, however, to reconstruct the shape from various fragments of the valves, and the above description is based in part on the information so obtained. The species is moderately long-ranged, and individually of no value as a zonal index. Moreover, it is generally rare in its occurrence, and in very few of the bore-core samples examined has it been found to be really abundant. The outstanding characteristics are the very finely and closely punctate shell, and the well developed marginal zone pierced by the radial pore canals. Variation in the number and arrangement of the radial pore canals and in the width of the marginal zone has been observed. In some individuals the radial pore canals are all of equal length, but in others they are of two and sometimes three different lengths, though always alternating in a regular manner. Sometimes they are very close together and almost contiguous throughout their length, but in other individuals they are more widely separated. Generally they appear to end in the bulbous enlargement. The width of the chitinised zone also varies in different individuals, and it is usually somewhat wider anteriorly and posteriorly than it is ventrally. It might also be mentioned that in some young and immature individuals no trace has been found of the radial pore canals. In some individuals the shell is thin, rather feebly calcified, and fragile, but in others it is heavily calcified, much more solid, and quite opaque. The recent *Cyprinotus* is generally considered as a subgenus of *Cypris,* and belongs to the subfamily *Cypridinae,* members of which are capable of swimming as well as creeping. The species has been named after the very finely and closely punctate shell of this ostracod.

Localities and Age: Bores 1, 3, 4, 5, 6, 12, 13 14 (see species occurrence charts), parish of Targinie and Rundle, county of Deas Thompson, The Narrows, between Gladstone and Rockhampton. This species has a vertical range of at least 182 feet, and its actual range may be considerably greater. Probably Miocene.

Genus Ilyodromus Sars, 1894.

Genotype: Ilyodromus obtusus Sars, 1894.

Diagnosis: Carapace in lateral view oblong. Dorsal margin variously arched. Ventral margin practically straight to gently sinuated. Valves equal, or left slightly larger than right. Carapace compressed. Hinge short, edentulous, somewhat thickened. Surface of valves usually ornamented with distinct lines or riblets, but sometimes smooth or very delicately striated.

Range: No Tertiary representative of the recent genus *Ilyodromus* appears to have been recorded previously.

ILYODROMUS? CONCENTRICUS, sp. nov. Plate VI, figs. 2 a, b.

Holotype: F. 1977, Queensland Geological Survey Collection. Locality: Bore 1, at 157 feet. Parish of Rundle, County of Deas Thompson, between Gladstone and Rockhampton, Queensland. Geological Horizon: The Narrows Tertiaries.

Description: Carapace small, in lateral view ovate to elliptical and subreniform, highest at about middle. Height rather greater than one-half of length. Dorsal margin gently and evenly arched. Ventral margin practically straight. Anterior extremity subacute, somewhat truncated dorsally. Posterior extremity more evenly rounded. Convexity of valves moderate, nearly regular, but rising rather more steeply from dorsal margin than from ventral. Position of greatest thickness of carapace located centrally. Valves subequal, left slightly overlapping right along ventral margin and the two extremities. Hinge somewhat thickened, occupying approximately central third of dorsal margin. In profile acute-ovate. In end view oval. Surface of valves delicately ornamented with elliptical riblets, reticulating to some extent, but generally concentric about apices of the two valves—i.e., the position of greatest thickness of carapace. Ornament somewhat resembling minute plicae or papillary ridges of human finger tip. Shell thin, fragile, chitino-calcareous, and transparent to translucent.

Dimensions of holotype: Length, 0·43 mm.; height, 0·25 mm.; approximate thickness of carapace, 0.2 mm.

Remarks: A search of available literature has failed accurately to place this species generically. In ornamentation and general shape, however, it resembles some species of the recent genus *Ilyodromus,* and it is here tentatively referred to that genus. However, the carapace is not so compressed and is much smaller than any of the recent species of this genus, so it may be generically distinct. It resembles most closely *Ilyodromus ellipticus* Sars, but differs in having the dorsal margin more strongly arched, the ornament more conspicuous and concentric instead of generally longitudinal, and in its much smaller size. It also shows some resemblance to *Ilyodromus obtusus* Sars, but here again the differences are quite marked. Both these recent species of *Ilyodromus* have been recorded from New South Wales (Henry, 1923).

This striking and easily recognised ostracod is moderately short-ranged, and a zone in The Narrows Tertiaries has been based on its proved vertical range of 115 feet—the Zone of *Ilyodromus? concentricus.* Through this interval the species has clearly been observed to increase gradually in abundance from very rare to very common, and, after reaching its acme, to decrease gradually until it becomes extinct. However, although it is very common in some of the samples from The Narrows, relatively few undamaged valves and complete carapaces have been found. This is apparently due to the very delicate and fragile nature of the shell and the fact that the valves are easily separated after death, since the hinge is edentulous. The outstanding characteristics of this species are the ornamentation and the small size. Some variation in outline within the species has been observed, which does not appear to be the result of crushing. While in most individuals the ventral margin

is either practically straight or slightly concave, in some it appears to be very slightly convex. Some variation in the ornament has also been noted. Although the riblets are generally wholly concentric about the apex of each valve, near the dorsal and ventral margin of some individuals they are arranged almost longitudinally. Their number and regularity also vary, and, if the number of reticulations joining them is great, the concentric arrangement may become rather confused. The size of all mature individuals of this species has been found to approximate to the dimensions given above for the holotype. The recent *Ilyodromus* is known to be a bottom dweller, creeping among the plants and in the mud of lake floors. It belongs to the subfamily *Herpetocypridinae,* all members of which are incapable of swimming in the adult state. Six species of the genus have been recorded from New South Wales, but only one species has been recorded as yet from Queensland (Henry, 1923). The species has been named after the characteristic concentric ornamentation of this little ostracod.

Localities and Age: In The Narrows Tertiaries: Bores 1, 3, 4, 5, 6, 12, 13, 14 (see species occurrence charts), parishes of Targinie and Rundle, county of Deas Thompson, between Gladstone and Rockhampton. This species has a vertical range of only 115 feet. *In the Petrie Series:* Houghton's bore, at about 45 feet, portion 24, parish of Warner, county of Stanley, near Lawnton, between Brisbane and Petrie. The fact that this species has been found at only the one locality in the Petrie Series suggests that it is a moderately short-ranged form. Probably Miocene.

Genus Erpetocypris Brady and Norman, 1889.

Genotype: Erpetocypris reptans (Baird), 1850, p. 160.

Diagnosis: Carapace in lateral view elongate. Height less than, or approximately equal to, one-half of length. Dorsal margin variously arched. Ventral margin sinuated in front of middle to almost straight. Valves rather unequal, left usually slightly larger than right. Surface of valves generally smooth, to punctate.

Range: Oligocene to Recent.

Erpetocypris aequalis Chapman, 1935. Plate VI, fig. 3.

Holotype: F. 7851, University of Queensland Collection. Locality: Gully on Portions 118, 119, 120, Parish of Bundamba, County of Stanley, about 5 miles S. of Goodna, Queensland. Geological Horizon: Redbank Plains Series.

Description: Carapace medium-sized, in lateral view elongate oval to subreniform, highest slightly in front of middle. Height approximately equal to, or slightly less than, one-half of length. Dorsal margin evenly and gently arched. Ventral margin nearly straight to slightly concave in median region. Anterior extremity broadly rounded, meeting ventral margin with moderately sharp angle. Posterior extremity well, but not so broadly, rounded. Valves moderately convex only, to rather compressed. Convexity fairly regular, and position of greatest thickness located slightly behind middle. Valves equal, or very nearly so. In profile acute ovate, with anterior extremity somewhat compressed and posterior roundly inflated. In end view oval. Surface of valves polished, smooth except for few scattered punctations. Seven muscle scars

conspicuous, five centrally to subcentrally placed forming a rosette, and two slightly removed anteriorly and ventrally, arranged obliquely, one above the other, sloping ventrally. Rosette consisting of three, generally sub-oval, scars in transverse row, with row of two, generally sub-oval, scars slightly below. Muscle scars sometimes very close together, and some almost or completely coalescent. Two scars above rosette generally more elongate and narrower than others. Small accessory muscle scars sometimes present, in addition to fundamental seven. Shell of medium thickness, chitino-calcareous, generally whitish, and translucent to opaque.

Dimensions of figured specimen from The Narrows: Length, 1·03 mm.; height, 0·51 mm.; approximate thickness of carapace, 0·45 mm.

Remarks: In describing this species from the Redbank Plains Series in 1935, Chapman had at his disposal only one small sample of ostracod-bearing shale, obtained from a surface outcrop. In this rather weathered material he found the carapace valves of this species strongly calcified, and owing to their opacity he was apparently unable to see the muscle scars on the inside of the valves. Recent examination of additional samples from Redbank Plains, however, has resulted in the discovery of a number of these valves with translucent shells clearly showing the muscle scar pattern described above. The species, accordingly, has been found to be identical with that recognised in The Narrows material and, with the additional material available, a more complete description is given.

E. aequalis compares very closely in shape with *E. strigata* (Müller), but differs from this recent European species, in having the extremities rather more broadly rounded, the carapace, particularly the anterior portion, more compressed, and in being approximately only half the size. No reference is made to muscle scars in the description of this recent species. As Chapman (1935, p. 68) has remarked, *E. aequalis* also "nearly resembles *E. glacialis* Sars, of the European lakes and marshes, in its convex dorsum and evenly rounded extremities." However, the valves, which are somewhat narrower and more compressed than those of *E. glacialis,* are highest slightly in front of the middle. *E. aequalis* is not as narrow or as elongate, although it has the same grouping of seven muscle scars, as *Candonocypris assimilis* Sars, an (H)erpetocyprid recorded and figured by Chapman (1919, p. 28) from the Pleistocene of Boneo Swamp, west of Cape Schanck, Victoria. The anterior extremity, moreover, is more broadly rounded than that of *C. assimilis,* and there are also other differences that separate it from this form.

This species has been found to be common in some of The Narrows bore-core samples, and in all the ostracod-bearing shale examined from the Petrie Series and the Baffle Creek Tertiaries. Although very few complete, undamaged valves have been found, a large number of valves with shells broken to varying degrees have been available for microscopic study. The outstanding characteristics of this simple, smooth-shelled ostracod are the outline, equality and compressed nature of the valves, and the muscle scar pattern. There appears to be little variation in shape (apart from the effects of crushing), but variation in the number and arrangement of the muscle scars has been noted. In many individuals the two scars closest to the dorsal margin have been found to be almost coalescent and, in some cases, completely fused into one long scar. The addition of a very small muscle scar to the ventral end of

both transverse rows of the central rosette has also been observed in a number of individuals. Although not definitely observed, indications of the presence of a narrow marginal zone have been seen around the anterior extremity of several valves. It is possible, moreover, that the apparent absence of a marginal zone may be the result of brittleness of the shell, and consequent breaking, especially around the free edges of the valves. In all individuals the shell has been found to be fairly strongly calcified, whitish, and translucent to opaque. The generic name *Erpetocypris* is written as *Herpetocypris* by most zoologists, and this genus belongs to the subfamily *Herpetocypridinae,* the members of which, as the name indicates, are creepers. They are, in fact, incapable of swimming in the adult state, and are only found creeping among the plants, and crawling and burrowing in the mud on the bottom.

Localities and Range: In The Narrows Tertiaries: Bores 1, 3, 4, 5, 6, 12, 13, 14 (see species occurrence charts), parishes of Targinie and Rundle, county of Deas Thompson, between Gladstone and Rockhampton. *In the Petrie Series:* Brecknell's Bore, at somewhere between 60 and 178 feet, subdivision 10 of portion 222, parish of Warner, county of Stanley, near Strathpine, between Brisbane and Petrie; from old well on portion 190, parish of Warner, approximately two miles W. of Strathpine; Houghton's Bore, at about 45 feet, portion 24, parish of Warner, near Lawnton; from Simpson's well, portion 186, parish of Nundah, county of Stanley, near Bald Hills, between Brisbane and Petrie. *In the Baffle Creek Tertiaries:* From No. 2 Shaft, portion 30, parish of Warro, county of Flinders, near Lowmead, between Bundaberg and Gladstone; from various depths in the Lowmead No. 1 Bore, in the N.W. corner of the above portion. *In the Redbank Plains Series:* Gully on portions 118, 119, 120, parish of Bundamba, county of Stanley, approximately five miles S. of Goodna, between Brisbane and Ipswich. This species is definitely a long-ranged form. Since it ranges through much of The Narrows material, and is common in all the Petrie Series, Baffle Creek, and Redbank Plains material examined, its range is probably Oligocene and Miocene.

ERPETOCYPRIS? SUBTRIANGULARIS, sp. nov. Plate VI, fig. 5.

Holotype: F. 1980, Queensland Geological Survey Collection. Locality: Bore 3, at 94 feet, parish of Rundle, county of Deas Thompson, between Gladstone and Rockhampton, Queensland. Geological Horizon: The Narrows Tertiaries.

Description: Carapace medium-sized, in lateral view subtriangularly obovate, highest near anterior third. Height somewhat greater than one-half of length. Dorsal margin obliquely arched, sloping gradually from position of maximum height to anterior extremity, but steeply to posterior extremity. Ventral margin almost straight. Anterior extremity broadly and evenly rounded. Posterior extremity narrowly and acutely rounded. Valves moderately convex to rather compressed. Convexity fairly regular, and position of greatest thickness located slightly behind middle. Valves subequal, left slightly overlapping right along ventral margin and the two extremities. In profile narrowly oval, with anterior part more compressed than posterior. In end view suboval. Surface unornamented, smooth except for few scattered punctations. Shell of medium thickness, brittle, chitino-calcareous, whitish, and translucent to opaque.

Dimensions of holotype: Length, 0·85 mm.; height, 0·47 mm.; approximate thickness of carapace, 0·4 mm.

Remarks: A search of available literature has failed accurately to place this species generically. It resembles some species of *Erpetocypris,* however, in its rather compressed, smooth, moderately calcified valves, but it is not as elongate as most species of this genus, the ratio of maximum height to length having been found to average 56:100. In certain species of *Erpetocypris,* however, the height is greater than half the length, and in *E. fasciata* (Müller) the posterior extremity is as narrowly rounded as in this species. Nevertheless, *E? subtriangularis* does not resemble very closely any of the described species of this genus. In shape, in fact, it is not unlike some species of the shallow-water marine genus, *Pontocypris* Sars, such as *P. trigonalis* Jones and Hinde. It differs from *P. trigonalis,* however, in having the height greater than half the length, and the anterior extremity more broadly rounded.

Although this ostracod is not abundant in The Narrows material, it has been found to be fairly common in some of the samples examined, and it has also been found at one locality in the Petrie Series. Unfortunately, however, very few undamaged valves have been found, and in many cases all that remains is an internal cast with small fragments of the shell sometimes present. This is apparently due to the very brittle nature of the shell and the fact that it is not very thick. The outstanding characteristic of this smooth-shelled ostracod is the subtriangular outline with the semicircular anterior extremity and the contracted, acutely rounded, posterior extremity. The species has been named after the characteristic subtriangular shape of the carapace valves.

Localities and Age: In The Narrows Tertiaries: Bores 1, 3, 4, 5, 6, 12, 13, 14 (see species occurrence charts), parishes of Targinie and Rundle, county of Deas Thompson, between Gladstone and Rockhampton. *In the Petrie Series:* Brecknell's Bore, at somewhere between 60 and 178 feet, subdivision 10 of portion 222, parish of Warner, county of Stanley, near Strathpine, N. of Brisbane. This species does not appear to be a long-ranged form. Probably Miocene.

Genus Stenocypris Sars, 1889.

Genotype: Stenocypris malcolmsonii (Brady), 1886, p. 297.

Diagnosis: Carapace in lateral view very narrow and elongate. Height considerably less than one-half of length, and nearly uniform. Dorsal margin very gently arched to almost straight. Ventral margin concave in median region. Anterior and posterior extremities rounded. Valves subequal, left slightly larger than right. Free edges smooth, inner duplicatures very broad, especially at the anterior extremity. In profile narrow oblong.

Range: No Tertiary representative of this recent freshwater genus appears to have been recorded previously.

Stenocypris lowmeadensis, sp. nov. Plate VI, fig. 8.

Holotype: F. 7915, University of Queensland Collection. Locality: From No. 2 Shaft, portion 30, parish of Warro, county of Flinders, near Lowmead, Queensland. Geological Horizon: Baffle Creek Tertiaries.

Description: Carapace medium-sized, in lateral view narrowly elongate, highest at about or slightly behind middle. Height considerably less than one-half of length. Dorsal margin very gently arched. Ventral margin almost straight, to slightly concave in median region. Dorsal and ventral margins tending to become nearly parallel. Anterior extremity rather subacutely rounded, somewhat truncated dorsally. Posterior extremity more evenly rounded. Valves only moderately convex. Convexity fairly regular, with position of greatest thickness of carapace located slightly behind middle. Valves subequal, left slightly overlapping right along ventral margin and two extremities. In profile narrow oblong-ovate. Surface of valves polished, smooth, and unornamented. Shell of medium thickness, brittle, chitino-calcareous, white, and translucent to opaque.

Dimensions of holotype: Length, 1·76 mm.; height, 0·75 mm.; approximate thickness of carapace, 0·65 mm.

Remarks: This ostracod compares fairly closely in both shape and size with certain species of *Stenocypris,* but does not appear to be identical with any previously described form. It is apparent that this is the ostracod which Chapman in 1935 (p. 70) tentatively determined as cf. *Paradoxostoma sp.* Unfortunately, he had at his disposal only one small sample of ostracod-bearing shale from the Baffle Creek Tertiaries, and almost all the valves it contained were particularly badly crushed. Furthermore, since, in its outline, this ostracod does show some general resemblance to *Paradoxostoma* Fischer, it is perhaps not surprising that Chapman tentatively compared it with that littoral, marine genus.

This species has been found to be quite common in the Baffle Creek ostracod-bearing shale, and it has also been recognised in the Redbank Plains material. Very few complete, undamaged valves have been found, apparently because of the brittleness of the shell and the fact that all the material has been very crushed. Although slight variations in outline have been observed, the ratio of height to length for most individuals has been found to be 41:100. Some indication of a marginal zone traversed by radial pore canals has been observed around the anterior extremity of several valves. It is possible, moreover, that the apparent absence of a marginal zone from most valves may be the result of the brittle nature of the shell and consequent breaking, especially around the free edges of the valves. The species has been named after the township of Lowmead in the Baffle Creek Tertiaries near where it was found. One recent species of this genus has been recorded by Sars (1889) from lagoons near Rockhampton.

Localities and Age: In the Baffle Creek Tertiaries: From No. 2 Shaft, portion 30, parish of Warro, county of Flinders, near Lowmead, between Bundaberg and Gladstone; from various depths in the Lowmead No. 1 Bore, in the N.W. corner of the above portion. *In the Redbank Plains Series:* Gully on portions 118, 119, 120, parish of Bundamba, county of Stanley, approximately 5 miles S. of Goodna, between Brisbane and Ipswich. Probably Oligocene.

Genus Cypridopsis Brady, 1868.

Genotype: Cypridopsis vidua (Müller), 1785.

Diagnosis: Carapace in lateral view elliptical to strongly ovate and tumid. Height generally greater than one-half of length. Dorsal margin broadly to sharply arched. Ventral margin straight to gently sinuate. Valves subequal, right generally the larger, with greatest overlap in median portion of ventral margin. Hinge short, occupying about one-third dorsal margin, simple, valves separated by narrow, knife-edged slit. Surface of valves smooth to pitted. Muscle scars slightly anteroventral of median point, each scar rather elongated.

Range: Permian to Recent.

Cypridopsis linearis, sp. nov. Plate VI, fig. 6.

Holotype: F. 1981, Queensland Geological Survey Collection. Locality: Bore 1, at 135 feet, parish of Rundle, county Deas Thompson, between Gladstone and Rockhampton, Queensland. Geological Horizon: The Narrows Tertiaries.

Description: Carapace medium-sized, in lateral view arcuately and broadly ovate, highest slightly behind middle. Height greater than one-half of length. Dorsal margin strongly arched. Ventral margin slightly concave in median region. Anterior extremity well rounded, but somewhat truncated dorsally. Posterior extremity broadly and more bluntly rounded. Valves moderately strongly convex with convexity almost regular. Position of greatest thickness of carapace located slightly behind middle. Valves unequal, right overlapping left anteriorly, ventrally and posteriorly. Surface of valves wholly ornamented with small flattened tubercles, generally arranged in rows. Tubercles circular to oval in outline, contiguous, and approximately 0·02 to 0·03 mm. in diameter. Ornament somewhat draught-board-like in pattern. Rosette of five, subcentrally placed, muscle scars sometimes conspicuous. Shell thin, fragile, chitino-calcareous, and transparent to opaque.

Dimensions of holotype: Length, 1·38 mm.; height, 0·91 mm.; approximate thickness of carapace, 0·75 mm.

Remarks: The high, tumid shape of this ostracod is characteristic of the genus *Cypridopsis*. Although it compares closely in shape with certain species of this genus it appears to be distinct from all previously described species.

It is not an abundant species in The Narrows material, but in some of the bore-core samples it has been found to be fairly common. Very few undamaged valves, however, have been found, and the above description is based in part on information obtained from fragments of the shell. The outstanding characteristic of this ostracod is the ornamentation. Some variation in outline within the species has been observed, which does not appear to be the result of crushing. While in most individuals the height nearly equals two-thirds of the length, in some cases it is only slightly greater than half the length. Variation in the ornament has also been noted. Although it generally shows a regular linear arrangement, in some individuals the ornament is much

less regular in its pattern and tends to resemble that of the well-known recent form *Newnhamia fenestrata* King. In some individuals, also, the posterior overlap of the right valve appears to be greater than in others. *Cypridopsis* belongs to the sub-family *Cypridopsinae,* members of which are capable of swimming as well as creeping, and are most abundant in permanent, shallow, still waters. The species has been named after the ornament which generally is linearly tuberculate.

Localities and Age: In The Narrows Tertiaries: Bores 1, 3, 4, 5, 6, 12, 13, 14 (see species occurrence charts), parishes of Targinie and Rundle, county of Deas Thompson, between Gladstone and Rockhampton. This species has a proved vertical range of only 82 feet, but its actual range may be somewhat greater. Probably Miocene.

Cypridopsis compressa Chapman, 1935. Plate VI, fig. 7.

Holotype: F. 7852, University of Queensland Collection. Locality: Gully on portions 118, 119, 120, parish of Bundamba, county of Stanley, about 5 miles S. of Goodna, S.E. Queensland. Geological Horizon: Redbank Plains Series.

Description: Carapace medium-sized, in lateral view arcuately ovate to broadly reniform, highest slightly behind middle. Height greater than one-half of length. Dorsal margin strongly arched. Ventral margin concave in median region. Anterior extremity well rounded, but somewhat truncated dorsally. Posterior extremity more broadly and evenly rounded. Valves only moderately convex, with convexity fairly regular. Position of greatest thickness of carapace located slightly behind middle. Valves subequal, right slightly overlapping left anteriorly, ventrally, and posteriorly. In profile ovate, with anterior extremity compressed and posterior somewhat inflated. Surface of valves smooth and unornamented. Rosette of five muscle scars, placed slightly anteroventrally of midpoint, conspicuous. Shell thin, fragile, chitino-calcareous, and translucent to opaque.

Dimensions of figured specimen from the Petrie Series: Length, 1·03 mm.; height, 0·65 mm.; approximate thickness of carapace, 0·5 mm.

Remarks: In describing this species from the Redbank Plains Series in 1935, Chapman had at his disposal only one small sample of ostracod-bearing shale obtained from a surface outcrop. In this rather weathered material he found the carapace valves of this species strongly calcified, and, owing to their opacity, apparently he was unable to see muscle scars on any of the valves. Recent examination of additional samples, however, has resulted in the discovery of a number of these valves with translucent shells clearly showing a rosette of five muscle scars. The species, accordingly, has been found to be identical with that recognised in the Petrie Series material, and, with the additional material available, a more complete description has been given.

As Chapman (1935, p. 68) has remarked, *Cypridopsis compressa* "bears a fairly close resemblance to *Cypridopsis picta* (Straus), a fresh-water form found in Norway, France, and Belgium." It differs from

the latter species, however, in its greater height, broader anterior extremity, less inflated posterior, and more compressed carapace.

The outstanding characteristics of this simple, smooth-shelled Cyprid are the outline of the valves, and the compressed nature of the carapace. There appears to be very little variation in the outline, and the ratio of height to length for most individuals has been found to be 62:100.

Localities and Range: In the Petrie Series: Brecknell's Bore, at somewhere between 60 and 178 feet, subdivision 10 of portion 222, parish of Warner, county of Stanley, near Strathpine, between Brisbane and Petrie; from old well on portion 190, parish of Warner, approximately two miles W. of Strathpine; Houghton's Bore, at about 45 feet, portion 24, Parish of Warner, near Lawnton; from Simpson's well, portion 186, parish of Nundah, county of Stanley, near Bald Hills. *In the Baffle Creek Tertiaries:* From No. 2 Shaft, portion 30, parish of Warro, county of Flinders, near Lowmead; from various depths in the Lowmead No. 1 Bore, in the N.W. corner of the above portion. *In the Redbank Plains Series:* Gully on portions 118, 119, 120, parish of Bundamba, county of Stanley, near Goodna. Probably Oligocene and Miocene.

Supplementary Note.

Possibly two other distinct species have also been found in The Narrows material, and one in the Baffle Creek material, but, because of the badly crushed and very fragmentary nature of the valves, accurate identification and systematic description has not been possible. However, some taxonomic work has been carried out and, when better material becomes available, it is hoped to complete the description of these forms.

PART III. CORRELATION OF DEPOSITS.

A. The Narrows.

General Aspects.

An extensive diamond-drilling campaign has been carried out recently by the Queensland Department of Mines in The Narrows Tertiary basin, in connection with the possible exploitation of its oil shales. Ostracods were discovered in the bore-cores from this drilling by Mr. L. C. Ball, Chief Government Geologist, and subsequent examination by the Queensland Geological Survey revealed their presence in much of the material. They were seen to persist sometimes through quite considerable thicknesses of the Tertiary shales, and it was thought that their palaeontological study might permit the correlation of the strata in the various bores.

An attempt has, accordingly, been made to arrive at a satisfactory correlation, by a detailed micropalaeontological examination of the ostracods contained in collections of samples from eight boreholes on

The Narrows. The samples examined were submitted by the Queensland Geological Survey, and were those selected from the regions where ostracods showed in quantity in the cores from Bores Nos. 1, 3, 4, 5, 6, 12, 13, and 14.

The Tertiaries of The Narrows, centred 15 to 20 miles N. of Gladstone, occupy a narrow belt of country on both sides of the strait that separates Curtis Island from the mainland. The area on the mainland lies largely within the parish of Targinie, but extends to the S. just into the parish of Calliope, and to the N.W. into the parish of Rundle, while the part of the basin on Curtis Island lies within the parishes of Curtis and Monte Christo. All the above parishes are in the county of Deas Thompson, except that of Calliope, which is in the county of Clinton. Topographically the country is lowland, the surface in most parts being not more than 50 feet above sea level.

Associated with the ostracods in these Tertiary shales, many of which are oil shales, gastropods belonging to the freshwater *Planorbis* group and fragmentary fish remains have been found. The association of fossil fish with ostracods in the same strata is not unnatural, however, for recent zoological study has shown that they are an important source of food for fish today. Coprolites, which may have come from such freshwater reptiles as crocodiles or chelonians, also have been found in the bore-cores.

Although the ostracods are very abundant in many of the samples they have generally been found to be crushed and broken. Some well-preserved individuals, nevertheless, have been found, but these are relatively uncommon, and usually occur in the better quality oil shales.

With reference to habitat, in seems that, in most cases, The Narrows fossil ostracods could have no other origin than burial *in situ*. It has been observed, also, that while they are generally more abundant in the oil shales, they are quite common in some of the non-bituminous shales in the bore-cores. They are, however, rare and completely absent from some of the bituminous as well as the non-bituminous shales. Thus, it is clear that the ostracods themselves have not played the principal role in the formation of the oil shales as such. It is pertinent to mention the fact, however, that freshwater ostracods are known to favour a still, shallow water environment containing sufficient organic material for them to pursue their scavenging habits, and that in such an environment they may be found in vast swarms swimming near the surface, or creeping among the plants and in the mud of the lake floor. Zoological study has also shown that while these minute, bivalved crustaceans are omnivorous, they feed largely on decaying algal material. This is interesting, for many oil shales are now regarded as being primarily of algal origin. Accordingly, it is not unnatural to find ostracods abundant in these shales, since they apparently frequented such an environment as that in which the shales were formed. Their scarcity and complete absence from some of the oil shales, also, may possibly be correlated with the fact that recent freshwater ostracods are very rare in waters extremely high in organic material.

Species Occurrence Chart Lists.

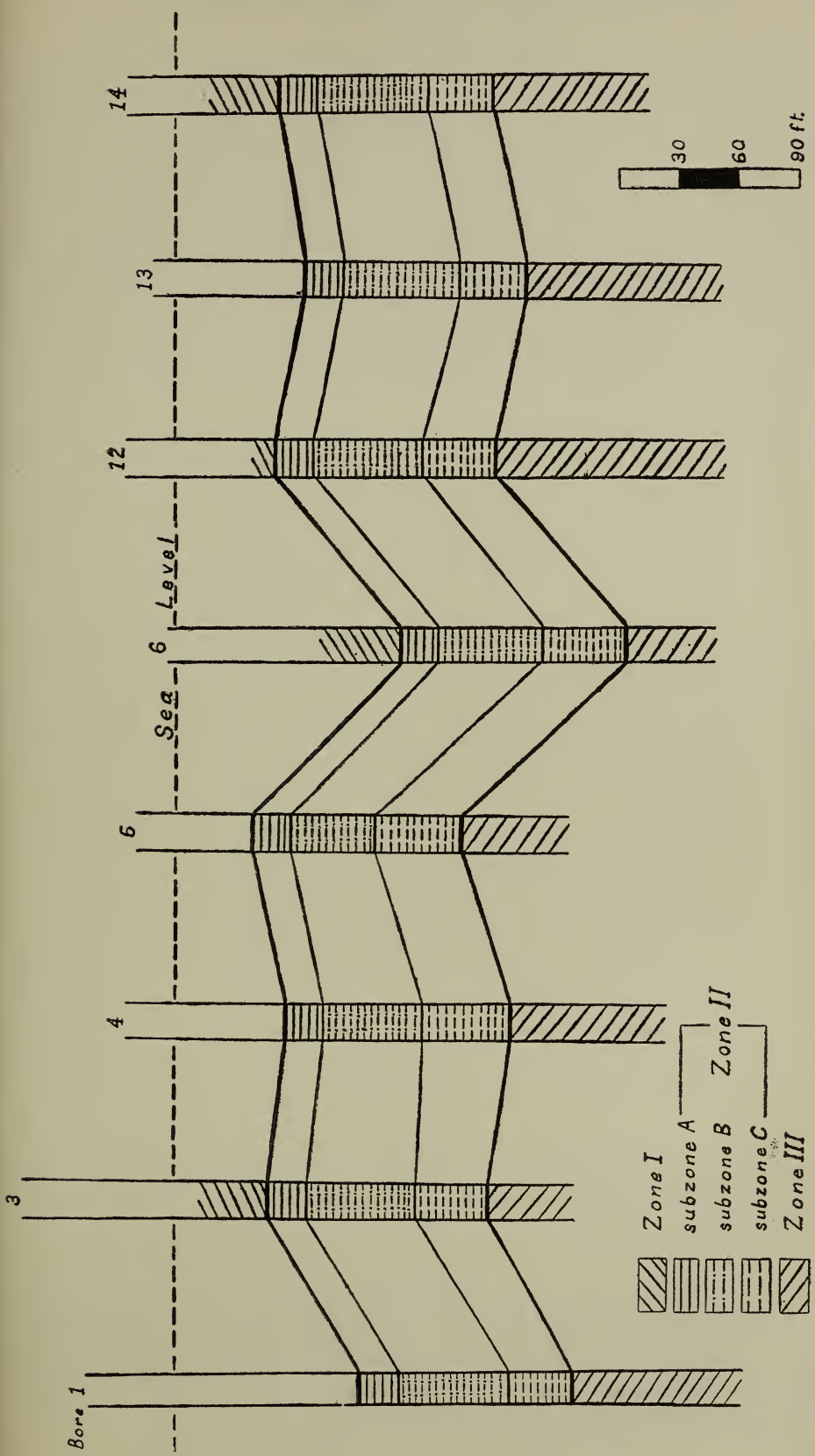
In the species occurrence charts that have been drawn up from a study of the ostracods contained in the bore-core samples, the following abbreviations are employed:—V.R.—Very Rare; R.—Rare; R-C.—Rare to Common; C.—Common.

Feet.	*Cypris munduranensis.*	*Ilyodromus? concentricus.*	*Cyprinotus punctatus.*	*Erpetocypris aequalis.*	*Erpetocypris? subtriangularis.*	*Cypridopsis linearis.*
			Bore I.			
135	R	VR	..	..	VR	C
137	R	VR	..	..	..	C
157	R–C	C	R–C	..	..	..
161	R–C	C	C	..	..	R
182	R–C	C	R–C	..	..	R
196	C	R–C	R	..	..	..
197	C	R–C	R	..	..	R
217	C	R	R	R	..	R
225	R–C	R	..	C	..	..
240	R–C	VR	R	R	..	..
260	C	..	R	R	..	..
284	R	..	R	..	..	..
297	R	..	R	R	..	..
321	R	..	R	..	..	..
			Bore III.			
94	R	..	..	..	C	R
112	C	..	..	..	C	C
170	..	VR	R	..	R–C	..
212	C	VR	R	R	..	..
220	C	VR	R	R	..	..
231	C	R	..	R	..	..
256	C	..	R	R	..	..
273	C	..	R	R	..	..
			Bore IV.			
81	R–C	VR	..	..	R	R
104	C	R–C	R	..	..	R
152	C	C	R	R	..	R
170	C	R–C	R	R	..	..
193	C	R	R	..	..	..
217	C	..	R	R	..	..
266	R	..	R–C	..	..	..
			Bore V.			
58	C	R	..	..	VR	R
70	C	R–C	VR	..	..	R
81	C	R	R	..	..	R
113	..	R	R	..	..	VR
162	C	VR	..	VR	..	..
175	C	..	R–C	R	..	..
190	C	..	..	R	..	..
214	R	..	R	..	..	..
			Bore VI.			
84	C	..	..	..	R	R
100	C	..	..	..	R	R
136	..	VR	R	..	..	VR
201	C	R	R	R	..	..
229	C	R–C	R–C	R	..	..
271	R	..	R–C	R	..	..

Feet.	*Cypris munduranensis.*	*Ilyodromus? concentricus.*	*Cyprinotus punctatus.*	*Erpetocypris aequalis.*	*Erpetocypris? subtriangularis.*	*Cypridopsis linearis.*
			Bore XII.			
76	C	R–C	..	..	R	R
92	R–C	R	..	..	..	..
115	C	C	R	..	..	R
138	C	R–C	..	..	..	..
164	C	R	R	R	..	R
185	C	R	R	..	..	..
204	C	..	..	R	..	..
211	C	..	R	R	..	..
232	R	..	..	..	..	..
258	C	..	R	..	..	..
261	C	..	..	R	..	..
274	C	..	R	R	..	..
296	C	..	R	..	..	..
			Bore XIII.			
78	R	VR	..	..	VR	R
124	R	R	R	..	..	R
127	C	R	R	..	..	R
133	C	VR	R–C	R	..	..
143	C	R	R	R	..	VR
205	R	..	..	..	..	..
246	R	..	R	R	..	..
256	R	..	..	..	..	..
269	C	..	R	R	..	..
284	C	..	R	..	..	..
			Bore XIV.			
64	R	..	..	..	..	R
70	C	..	..	..	VR	..
74	R	VR	..	..	..	R
79	C	..	R–C	..	..	R
100	C	VR	..	..	..	..
123	C	..	R		..	R
135	R	VR	R	..	..	..
140	C	..	R	..	..	..
147	C	R	R	..	..	VR
150	C	R	R	..	..	..
154	C	..	R	..	..	..
162	R	..	R–C	R–C	..	..
176	R	..	R	R	..	..
205	..	..	VR	R	..	..
215	C	..	R–C	R	..	..
261	C	..	R–C	..	..	..

Zonal Correlations.

From a study of the above species occurrence charts it will be seen that the vertical range of *Ilyodromus? concentricus* is approximately 115 feet. Although in Bores III, XIII, and XIV the proved vertical range of this species is, respectively, only 61, 65, and 76 feet, it is apparent that these figures do not represent the complete range, since only widely-spaced and relatively small samples from these bore-cores were available for study. In all of the other bores the vertical range approximates to, but does not exceed, 115 feet. From this general persistence a broad zone, some 115 feet in thickness, has been set up. It has been called the *Zone of Ilyodromus? concentricus.*



Text Fig. 1.

Diagram of Bores at The Narrows, showing division of strata into zones, and correlations.

This Zone has been divided into three Subzones, on the presence or absence of the other ostracod species. In the uppermost of these Subzones, which is approximately 20 feet in thickness, *Cypris munduranensis, Ilyodromus? concentricus, Cypridopsis linearis,* and *Erpetocypris? subtriangularis* are present, while *Cyprinotus punctatus* and *Erpetocypris aequalis* are absent. This subzone has been called *Subzone A.* Underlying it is *Subzone B,* approximately 50 feet in thickness, and characterised by the presence of *Cypris munduranensis, Ilyodromus? concentricus, Cyprinotus punctatus,* and *Cypridopsis linearis,* and the absence of *Erpetocypris aequalis* and *Erpetocypris? subtriangularis.* This in turn is underlain by *Subzone C,* which is approximately 45 feet in thickness, and is characterised by the presence of *Cypris munduranensis, Ilyodromus? concentricus, Cyprinotus punctatus,* and *Erpetocypris aequalis,* and the absence of *Cypridopsis linearis* and *Erpetocypris? subtriangularis.*

The Zone of *Ilyodromus? concentricus* is overlain by *Zone I,* from which *Ilyodromus? concentricus, Cyprinotus punctatus,* and *Erpetocypris aequalis* are absent, but in which *Cypris munduranensis, Erpetocypris? subtriangularis,* and *Cypridopsis linearis* are present. This zone is represented only in the samples submitted from Bores III, VI, XII, and XIV, and, because of the long ranges of the species present, it is not possible to divide it into subzones. It is at least 25 feet in thickness.

The Zone of *Ilyodromus? concentricus*—or *Zone II*—is underlain by *Zone III,* in which *Ilyodromus? concentricus* is again absent. In this zone, which is at least 100 feet thick, *Cypris munduranensis, Cyprinotus punctatus,* and *Erpetocypris aequalis* are present, but *Erpetocypris? subtriangularis, Cypridopsis linearis* and *Ilyodromus? concentricus* are absent. Unfortunately, owing to the long ranges of the three species present, it has not been possible to divide this broad zone into subzones.

From this division into zones, based on a study of the eight species occurrence charts, an approximate correlation of the strata in the portions of the various bores examined has been arrived at and the accompanying chart drawn up. For security reasons, no information concerning the exact location, relative position, and depth of these bores is at present available. Accordingly, the accompanying chart does not suggest any structural phenomena, but is one of zonation and correlation only. Although the relative position of the various bores has not officially been disclosed, however, they are known to be quite widely separated from one another, so that little, if any, structure could be deduced with safety from a correlation chart, even if the exact spacing were known.

The surface elevation, respectively, at Bores I, III, IV, V, VI, XII, XIII, and XIV has officially been given as 45, 80, 25, 20, 5, 25, 12, and 25 feet, and this variation is shown on the correlation chart (Text Fig. 1).

Discussion.

In conclusion, it may be said that, although the ostracod species found in The Narrows Tertiary shales have proved somewhat disappointing for purposes of close zonation, the recognition of various characteristic faunal assemblages has enabled the division into zones and approximate correlation of the strata in the various bores.

Taxonomic work on The Narrows ostracods and the referring of all the species to freshwater genera has also been important, since it indicates a lacustrine origin for these Tertiary shales. Furthermore, since freshwater fish, unionids, freshwater gastropods, and dicotyledonous leaves have also been recorded from this Tertiary basin, it now seems clear that the deposit is wholly a freshwater one.

The study and identification of the various ostracods has provided certain information concerning the environmental conditions of deposition and origin of these ostracod-bearing shales. The presence and wide distribution of species which have been referred to the genera *Erpetocypris, Ilyodromus* and *Cypridopsis* suggest that the lake was shallow but probably of a permanent nature, that its floor was covered in part with mud, decayed vegetable matter and algae, and that the temperature of the water was probably very close to that found in similarly situated lakes today. Ostracods belonging to the genera *Erpetocypris* and *Ilyodromus* are found today only on the floors of shallow lakes and ponds, creeping among the plants, crawling and burrowing in the mud, and feeding mainly on algae. Furthermore, although *Cypris, Cyprinotus* and *Cypridopsis* are swimmers as well as creepers, they are known to occur most abundantly in still, shallow waters containing a moderate amount of organic material. Accordingly, it seems clear that The Narrows ostracod-bearing shales were laid down under the above environmental conditions and, since algal and other vegetable material was present in varying amounts, it is not surprising to find that many of these shales are somewhat bituminous. Certain parts of this Tertiary lake, where the environment was particularly favourable, must have teemed with ostracods at the time. It might also be mentioned that, from the wide geographical and stratigraphical distribution of the ostracods in the basin, it would seem that these environmental conditions must have extended over a fairly considerable part of the lake, and existed intermittently at least for the time necessary for the deposition of several hundred feet of shale. It can be concluded, therefore, that the area was slowly subsiding.

The fact that ostracods are scarce and completely absent from some of the shales passed through in boring, however, indicates that the above environmental conditions did not extend over the whole lake and throughout the entire period of deposition. One other environment, in which the amount of vegetable material was so great that the water was probably unsuitable for the presence of ostracods, is suggested by their absence from most of the higher-grade bituminous shales. Another environment, also, in which the amount of vegetable material was very small and ostracods were not abundant, is indicated by their scarcity in the coarser-grained, non-bituminous shales. Since freshwater gastropods have, on the other hand, been found to be more prevalent in these coarser-textured shales, they apparently favoured this environment.

Finally, it must be admitted that the ostracods identified have not proved of very great value for the determination of the precise age of The Narrows Tertiaries. It is clear, however, that the fauna is fairly closely allied to the present-day one, since all the species described have been referred to living genera. It is possible, moreover, that some of the forms described may even be identical with living, but as yet undescribed species, or that some may be very closely related to such forms. Until the recent freshwater ostracod fauna of Queensland has been completely

described and detailed accounts of the structure of the carapace valves have been given, however, no very definite comparisons can be made. The presence of *Cypris* and *Cypridopsis* in the material, unfortunately, is of no value for purposes of age determination, since, although both these genera occur mainly in the Tertiary, their ranges extend back to the Jurassic and the Permian respectively. The genera *Erpetocypris, Ilyodromus* and *Cyprinotus,* however, are of some value. They are found only in the Tertiary and Recent and neither *Ilyodromus* nor *Cyprinotus* appears to have been previously recorded from the Tertiary. *Erpetocypris,* however, has been recorded from the Redbank Plains Series, which is probably of Oligocene age (Hills, 1934), and the known backward range of this genus was thereby extended considerably. Accordingly, it seems most unlikely that the age of The Narrows Tertiaries is pre-Oligocene. The presence of more recent genera than are found in the Redbank Plains Series, in fact, strongly suggests that the age of the beds is post-Oligocene. However, since none of The Narrows species seems to be identical with any of the described recent Australian forms, it is improbable that the shales are of Upper Tertiary age, as Pliocene and Pleistocene ostracod faunas generally are identical with recent ones. Moreover, it has already been shown that certain of The Narrows species were short-ranged, and some members of the fauna are definitely known to be extinct. However, since all but one of the species described have been found to be new, it is apparent that the species themselves cannot at present provide more precise information concerning the age of the strata.

All the above information seems to indicate a probable Miocene age for The Narrows Tertiaries. This agrees with Hills' recent determination (1943), from a study of the fossil fish, that "the age of the strata is probably Miocene." When more taxonomic work has been carried out on Tertiary and Recent freshwater ostracods, however, and the geological ranges of the various genera and species have been accurately determined, a more precise and definite age determination may be possible.

B. Petrie Series.

General Aspects.

As mentioned above, ostracods have been recorded by Ball (1932) and the present writer (1944) from four places in the Petrie Series, where they were found in shales brought up on putting down wells and bores.

The Petrie Series, situated just N. of Brisbane, was named and originally described by Jones in 1927, and a more detailed, supplementary account was given by the present writer in 1944. The series occupies a roughly circular area of some fifteen square miles centred about Strathpine (14 miles by rail N. of Brisbane) and is made up largely of shales, which owing to their soft nature seldom outcrop.

As well as the occurrence of ostrocods, unionids, fossil fish and various plant remains have also been found in this Tertiary basin and, on palaeontological and lithological evidence, a provisional Miocene age has already been given to the series (Beasley, 1944).

Unfortunately, only a small collection of ostracod-bearing shale samples from the Petrie Series has been available for micropalaeontological examination. A few small samples were obtained from Houghton's bore at Lawnton, but most of this material was very much crushed and broken up by percussion drilling. Only two samples were found on the spoil heap of the old well on portion 190, parish of Warner and, although more material was collected from Simpson's well, E. of Bald Hills, it had weathered practically to a soil and almost all the ostracods were present only as internal casts. Most of the material so far collected has, in fact, come from Brecknell's bore at Strathpine, and this has provided the basis for the micropalaeontological work that has been carried out. Quantitatively, however, the amount of ostracod-bearing shale available for study even from this bore was not great and, as the material had lain on the surface for several years, it had weathered and become still further broken up.

Although much of the ostracod-bearing shale that has been collected is rich in ostracod remains, most of the valves are even more crushed and broken than those from The Narrows. An intensive microscopic search, however, has revealed a number of identifiable forms which have given some indication of the fauna and its affinities.

In the collection of samples examined, the species present in order of abundance are:—*Erpetocypris aequalis* Chapman, 1935; *Cypris munduranensis* sp. nov.; *Cypridopsis compressa* Chapman, 1935; *Ilyodromus? concentricus* sp. nov.; *Erpetocypris? subtriangularis*, sp. nov.

Discussion.

Considered as a whole, the known ostracod fauna of this series shows a very close affinity with that described above from The Narrows Tertiaries. In fact, four of the five species identified—namely, *Cypris munduranensis, Ilyodromus? concentricus, Erpetocypris aequalis,* and *Erpetocypris? subtriangularis*—are found in The Narrows Tertiaries. In the presence of the other species, *Cypridopsis compressa,* as well as of *Erpetocypris aequalis,* however, some affinity is shown with the fauna of the Redbank Plains Series described by Chapman in 1935. Although *Erpetocypris aequalis* and *Cypridopsis compressa* are common members of the Petrie Series fauna, it must be borne in mind that most simple, smooth-shelled Cyprids are long-ranged, so that the occurrence of these species needs not necessarily suggest approximately equivalent ages for the two series. In fact, the presence of these two ostracods in all the Petrie Series ostracod-bearing shale at present available suggests that they are moderately long-ranged forms. Accordingly, in evaluating the Petrie Series ostracods as a criterion of age, it is necessary to consider all members of the fauna. When this is done, there is definitely a much closer relationship between the Petrie Series and The Narrows ostracod faunas than between the former and that of the Redbank Plains Series.

From this similarity in their ostracod faunas, and the fact that two of the species common to them are moderately short-ranged forms, it seems that the Petrie Series is equivalent in age to The Narrows Tertiaries. Since a probable Miocene age has already been suggested for The Narrows Tertiaries from a study of its ostracod fauna (see above), a probable Miocene age, then, can also be postulated for the Petrie Series.

The recognition in the Petrie Series of so many of the same species as are found in The Narrows Tertiaries also suggests similar environmental conditions of deposition for the ostracod-bearing shales in both these Tertiary basins. (For a detailed account of these, see above.)

Finally, the discovery of *Ilyodromus? concentricus* in the material from Houghton's Bore near Lawnton has been of particular importance, since this species proved to have a vertical range of only 115 feet in The Narrows Tertiaries. Accordingly, the ostracod-bearing shale encountered at about 45 feet in Houghton's Bore may reasonably be correlated with some horizon within this 115-foot thickness. Furthermore, as this species has been found to be quite common in the Lawnton material, it may be stratigraphically equivalent to an horizon somewhere near the central part of the Zone of *Ilyodromus? concentricus* in The Narrows Tertiaries. It has, therefore, been possible to correlate a horizon in the Petrie Series at least approximately with an equivalent one in The Narrows Tertiaries.

C. Baffle Creek.

General Aspects.

Immediately before and during the early part of the 1914-1918 war some consideration was given to the possibility of exploiting the oil shales of the Baffle Creek Tertiaries, and a number of shafts and a deep bore—the Lowmead No. 1 Bore—were put down in the southern part of the basin. A small collection of samples from some of these sinkings are now in the Museum of the Department of Geology, University of Queensland, and have recently been examined by the writer. All the shale samples in this small collection are somewhat bituminous in nature, but ostracods have not been found in all the specimens. In some, however, they have been found to be exceedingly abundant, and so closely packed that it is impossible to distinguish the individual outlines of the valves accurately.

The Baffle Creek Tertiaries, situated in the upper part of the Baffle Creek valley, about midway between Bundaberg and Gladstone, are known to occupy a belt of country some eleven miles long and one to two miles wide, and to have a probable area of some thirty square miles. They extend from near Lowmead (48 miles N. of Bundaberg) almost to Colosseum (6 miles S. of Miriam Vale) on the main North Coast Railway.

As well as ostracods, Ball (1916, p. 15) has recorded indeterminable carbonised stem fragments, sponge gemmules, freshwater gastropods and chelonian remains from the Tertiary shales, and dicotyledonous leaves and unionids from the associated argillaceous sandstones in the basin.

Ball (1914a, p. 21) has also stated that the Baffle Creek "shales closely resemble those of the Oxley district, near Brisbane, not only in lithological characters but in their fossil contents."

The ostracod-bearing shales examined are all from portion 30, parish of Warro, county of Flinders. A number of them are from various depths in the Lowmead No. 1 Bore, which was put down in the N.W. corner of portion 30, about a quarter of a mile from the railway and some two miles W.N.W. of Lowmead railway station. Several of the samples are from No. 2 Shaft, in the centre of portion 30, near the

bank of Marked Tree Creek, and the remainder are believed to have come from outcropping shales also on this portion.

Unfortunately, all the material that has been available for study is very badly crushed—even more so than that from The Narrows or the Petrie Series—and detailed micropalaeontological work has been particularly difficult.

The species identified in the collection of samples, in order of their abundance, are:—*Erpetocypris aequalis* Chapman, 1935; *Stenocypris lowmeadensis* sp. nov.; *Cypridopsis compressa* Chapman, 1935.

Discussion.

From our present knowledge, the ostracod fauna of the Baffle Creek Tertiaries seems to show a fairly close resemblance to that of the Redbank Plains Series. The known ostracod faunas of both these basins are smaller than that of either The Narrows Tertiaries or the Petrie Series, and in both the Baffle Creek Tertiaries and the Redbank Plains Series the forms *Erpetocypris aequalis* and *Cypridopsis compressa* are prominent. Since only three species have so far been identified from both of these basins, the similarity in their ostracod faunas is all the more marked. Although *Erpetocypris aequalis* and *Cypridopsis compressa* are known to be long-ranged forms, their common occurrence and the absence of several species found in The Narrows and the Petrie Series material show that the faunas of the Baffle Creek Tertiaries and the Redbank Plains Series are distinctly different from those of the above basins, and suggest a somewhat different geological age. It might also be mentioned that a recent examination of the Redbank Plains ostracod-bearing shale has resulted in the discovery of *Stenocypris lowmeadensis* in that material, so that this long, narrow ostracod also occurs in both the Baffle Creek Tertiaries and the Redbank Plains Series, but has not been found in The Narrows Tertiaries or the Petrie Series.

Accordingly, from this similarity in their ostracod faunas, it seems likely that the Baffle Creek Tertiaries are approximately equivalent in age to the Redbank Plains Series. Although the ostracods themselves, in this case, do not give any information as to the exact age of these beds, it might be mentioned that Hills (1934), from a study of the fish remains, has concluded that the Redbank Plains Series is most probably of Oligocene age. It therefore seems that the Baffle Creek Tertiaries also are probably Oligocene in age.

The referring to freshwater genera of the ostracods determined from the Baffle Creek Tertiaries has also further supported the concept that the basin is wholly a freshwater one.

Finally, mention might be made of the fact that geographically the Baffle Creek Tertiaries and the Redbank Plains Series are centred about the same distance inland from the present coastline, while The Narrows Tertiaries and the Petrie Series, on the other hand, respectively are found adjoining and adjacent to the present coastline.

PART IV. GENERAL CONCLUSIONS.

Palaeontological work on the above ostracod faunas has clearly demonstrated their stratigraphical value. It has been possible to draw up a broad zonal correlation of The Narrows bores, and to correlate a number of the isolated Tertiary basins. The Narrows Tertiaries and the

Petrie Series are considered as being most probably Miocene in age, and the Baffle Creek Tertiaries and the Redbank Plains Series as probably Oligocene. This has confirmed Hills' conclusion (1943), from a study of the fish fauna of two of these basins (Redbank Plains and The Narrows), that the Tertiary deposits of Eastern Queensland are not all contemporaneous.

The environmental conditions of deposition for these ostracod-bearing shales indicate that the lakes were largely shallow but probably of a permanent nature, that their floors were covered in part with mud, decayed vegetable matter and algae, that the temperature of the water was probably very close to that found in similarly situated lakes today, and that the lakes were all freshwater ones. Slow subsidence during deposition, also, is indicated by the thicknesses of ostracod-bearing shales that contain a shallow-water fauna.

The absence of ostracods from some of the oil shales and their presence in non-bituminous shales show that they are not the principal contributor to the kerogen of the oil shales in these basins. Their common occurrence in them, however, is natural, since they favoured an environment rich in algal material such as that in which these oil shales were formed and, in most cases, they were apparently buried *in situ*. By partial decomposition of the soft parts of the animal, however, the ostracods may have contributed in some small measure to the formation of the oil shales. A partial animal origin has, in fact, been suggested by Ball (1914b, p. 74) for some of The Narrows and Baffle Creek oil shales, and by the present writer (1944, p. 98) for some of the Petrie Series oil shale.

It is probable that the ostracods contained in the shales of some of the Tertiary basins, other than The Narrows, will also prove of value for zonal correlation purposes in the future. Since drilling operations will be necessary for the adequate study of all these basins, more sets of bore-cores should eventually become available and so enable attempts at zonation and correlation of the strata to be made.

In conclusion, it may be said that, although the ostracods have not yet proved of very great value for the determination of the precise age of the various deposits, they have already given some indication of their probable ages. When more work has been carried out on Tertiary and Recent freshwater ostracods, and the geological ranges of the various genera and species have been accurately determined, more precise age determinations for some of these basins may be possible.

Acknowledgments.

This work was financed by the Commonwealth Government Grant through the Council for Scientific and Industrial Research to the University of Queensland. The writer would like to thank Mr. O. A. Jones and Dr. W. H. Bryan for their helpful advice, and Professor H. C. Richards for his personal interest in enabling him to carry out this work. The material from The Narrows was submitted for examination by the Chief Government Geologist, Mr. L. C. Ball. The drawings are the work of Mr. R. Gradwell.

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Explanation of Plate VI.

Fig. 1 *a*, *b*.—*Cypris munduranensis* sp. nov.; *a*, right valve, lateral view; *b*, profile of same valve. Holotype. × 80.

Fig. 2 *a*, *b*.—*Hyodromus? concentricus* sp. nov.; *a*, right valve, lateral view; *b*, profile of same valve. Holotype. × 80.

Fig 3.—*Erpetocypris aequalis* Chapman. Left valve, lateral view. F. 1979, Queensland Geological Survey Collection. Bore 1, at 225 ft., The Narrows Tertiaries. × 40.

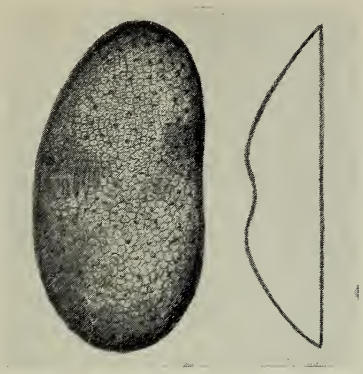
Fig. 4 *a*, *b*.—*Cyprinotus punctatus* sp. nov.; *a*, right valve, lateral view; *b*, profile of same valve. Holotype. × 20.

Fig. 5.—*Erpetocypris? subtriangularis* sp. nov. Left valve, lateral view. Holotype, × 40.

Fig. 6—*Cypridopsis linearis* sp. nov. Right valve, lateral view. Holotype. × 20.

Fig. 7.—*Cypridopsis compressa* Chapman. Right valve, lateral view. F. 7912, University of Queensland Collection. Brecknell's Bore, Petrie Series. × 30.

Fig 8.—*Stenocypris lowmeadensis* sp. nov. Left valve, lateral view. Holotype. × 20.



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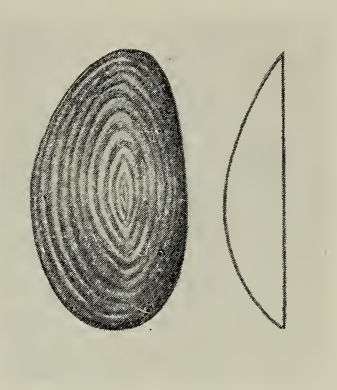

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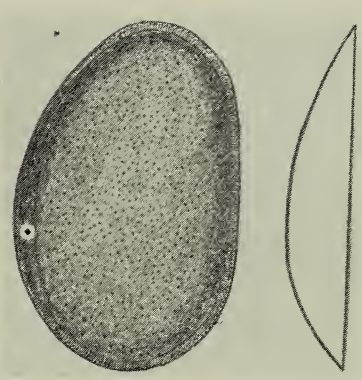
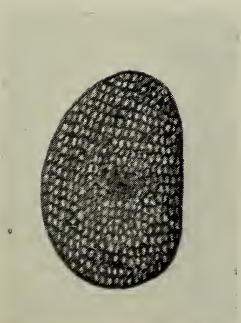


4a 4b

5



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7

8

A PAPUAN ORCHID.

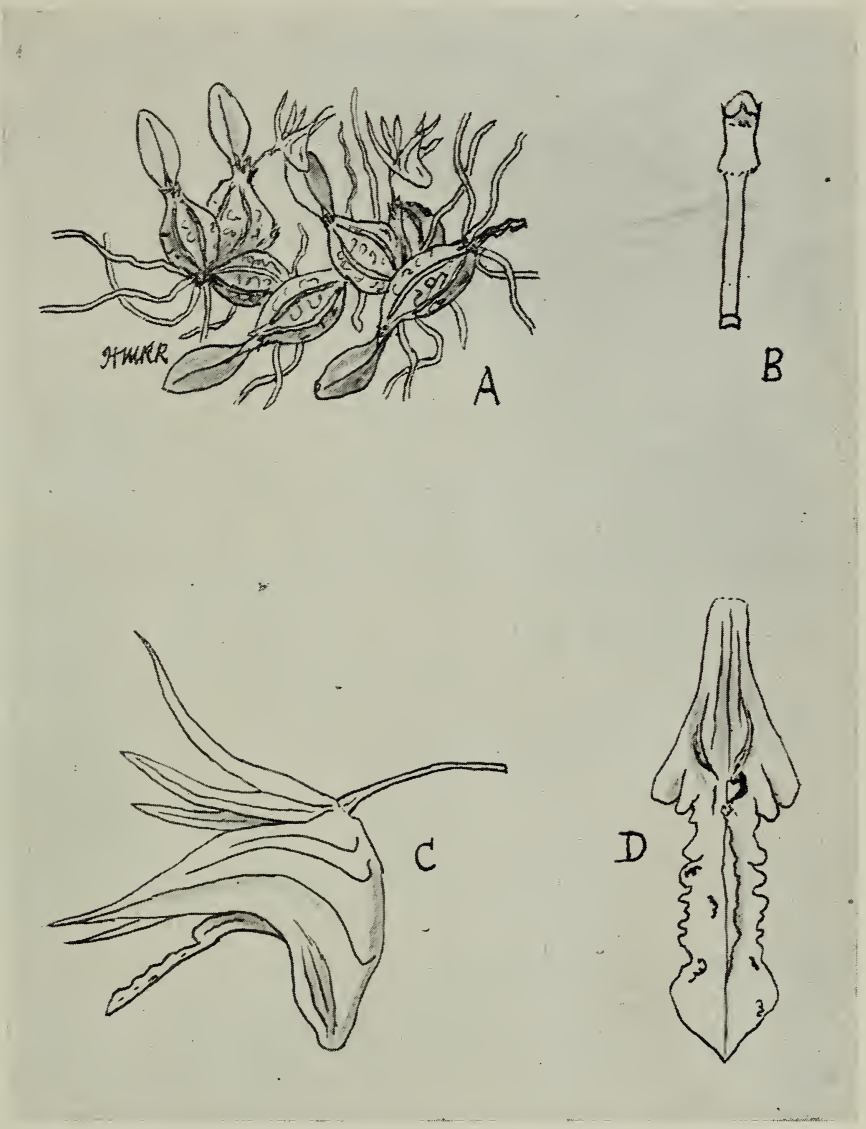
Dendrobium Coplandii (Bailey) Rupp, comb. nov.

By H. M. R. Rupp, Northbridge, N.S.W.
(Communicated by C. T. White.)

(With Plate VII.)

(*Received 26th October*, 1944; *accepted for publication, 30th October*, 1944; *issued separately, 29th June*, 1945.)

This little Papuan orchid was discovered by the late Rev. Copland King near Ambasi, and was named in his honour by F. M. Bailey, who described it in *Queensl. Agric. Journ.* xvii (1906), 232, under the name *Bulbophyllum Coplandii*. The structure of the flower suggests that it would be better placed in *Dendrobium*. The length of the petals, the large spur, and the trilobate labellum with raised longitudinal lines or ridges, are all more characteristic of the latter genus than of *Bulbophyllum*. In the National Herbarium of New South Wales there are specimens in good condition sent by the Rev. P. C. Shaw from Ambasi in June 1906, and it is from these that a study of the plant has been made by the present writer. The labellum is very long and narrow, and in dried material its details are difficult to distinguish; but after softening out a flower, the small lateral lobes could be unfolded, and the longitudinal ridges were revealed—one of them apparently continuing along the greater part of the middle lobe. The margins of the lobes are irregularly crenulate-crisped. The foot of the column is very long, corresponding with the length of the large spur, and the labellum is articulate with its apex by a very short claw.



Dendrobium Coplandii (Bail.) Rupp.

A—Portion of a plant, natural size.

B—Column, showing the long foot.

C—A flower, with labellum partly pulled out between the lateral sepals.

D—Labellum from above.

} Enlarged.

The Royal Society of Queensland.

Report of Council for 1943.

To the Members of the Royal Society of Queensland.

Your Council has pleasure in submitting the Annual Report of the Society for the year 1943.

At Ordinary Meetings three addresses were given, two exhibit evenings, and two symposia held, while one meeting was devoted to films and a short address. Six original papers were accepted for publication in the Proceedings.

The Chief Secretary's Department has agreed to pay a £1 for £1 subsidy for printing on papers 1-8 published in Volume LIV. of the Proceedings and judged of value from a governmental point of view. The Council acknowledges this subsidy with gratitude.

A large portion of the library, which had been stored in the basement as a precautionary measure during the previous year, was returned to the Royal Society room. A complete recataloguing of the library was undertaken, and this has been completed largely owing to the efforts of Mr. Pennington, whose assistance to the honorary librarian is warmly appreciated by the Council.

During the year a deputation consisting of Prof. Richards, Mr. Perkins, and Prof. Bostock was received by the Premier, the Hon. F. A. Cooper, to discuss library facilities in post-war needs. Mr. Cooper gave an assurance that in the planning of a Central Library for the State, favourable consideration would be given to the housing therein of the library of the Royal Society. He also approved of financial assistance being given to the Society for the binding of journals to the extent of £50 5s.

There are 3 honorary life members, 4 life members, 3 corresponding members, 196 ordinary members, and 9 associate members in the Society. This year the Society has lost 2 members by death and 3 by resignation, while 11 have been elected to ordinary membership and 7 to associate membership.

The Council would like to place on record its regret at the death of the late Mr. Henry Tryon. Mr. Tryon was an original member of the Society and the first Secretary. He was also one of the first honorary life members, and took an active interest in the affairs of the Society until his death.

Attendance at Council meetings was as follows:—J. Bostock 7, D. H. K. Lee 8, F. A. Perkins 7, E. W. Bick 10, M. Scott 9, I. R. Bick 8, S. T. Blake 6. M. F. Hickey 8, W. H. Bryan 6, H. J. G. Hines 6, T. G. H. Jones 7, E. M. Shepherd 5, C. Clark 0.

JOHN BOSTOCK, President.

MARGARET I. R. SCOTT, Hon. Secretary.

THE ROYAL SOCIETY OF QUEENSLAND.

STATEMENT OF RECEIPTS AND EXPENDITURE FOR YEAR ENDED 31st DECEMBER, 1943.

Cr. **Dr.**

RECEIPTS.

	£	s.	d.
Balance, Commonwealth Bank, 31st December, 1942 ..	42	19	0
Subscriptions	151	4	0
Sales of Reprints	1	10	0
Interest on Commonwealth Bonds	4	11	3
Savings Bank Interest	2	4	1
Refreshments, Collections	6	0	3
Exchanges	0	8	0
	£208	16	7

EXPENDITURE.

	£	s.	d.	£	s.	d.
Government Printer—						
Abstracts		..		12	3	6
Volume	123	13	4			
Less Subsidy by Government ..	54	7	9			
				69	5	7
Hon. Secretary, Postages		..		9	12	11
Stationery		..		2	5	9
Refreshments		..		6	3	10
Lanternist		..		1	17	6
Hon. Librarian, Postages		..		2	0	0
Hon. Treasurer, Postages and Duty ..		..		1	15	0
State Government Insurance (Library) ..		..		0	14	5
P. J. Firth Ltd., Pamphlet Covers (Library)		..		2	3	9
Wreath, Funeral Late H. Tryon ..		..		1	3	0
Cash in Hand		..		1	1	0
Balance in Commonwealth Bank		..		98	10	4
				£208	16	7

Examined and found correct.

L. P. HERDSMAN, Hon. Auditor.

14th February, 1944.

E. W. BICK, Hon. Treasurer.

Abstract of Proceedings, 27th March, 1944.

The Annual Meeting of the Society was held in the Geology Department of the University on Monday, 27th March, 1944, at 8 p.m. The Chair was occupied by the President (Prof. J. Bostock). An apology was received from the Patron, His Excellency the Governor. Thirty members and friends were present. The minutes of the previous annual meeting were read and confirmed. The Annual Report was adopted and the Balance-sheet received. Miss Barbara Campbell was nominated for Ordinary Membership and Mr. E. G. Le Breton for Associate Membership. It was decided to send a congratulatory telegram on behalf of the Society to Prof. O. W. Tiegs on his recently conferred F.R.S.

The following officers and Council were elected for 1944:— President, Mr. F. A. Perkins; Vice-Presidents, Prof. J. Bostock and Prof. H. J. Wilkinson; Hon. Secretary, Miss M. Scott; Hon. Treasurer, Mr. E. W. Bick; Hon. Editors, Dr. M. F. Hickey and Mr. S. T. Blake; Hon. Librarian, Mr. I. R. Bick; Members of Council, Prof. T. G. H. Jones, Prof. D. H. K. Lee, Mr. O. A. Jones, Mr. E. M. Shepherd, and Mr. R. Pennington; Hon. Auditor, Mr. L. P. Herdsman.

The Presidential Address, "A Retrospect of Modern Psychiatry," was delivered by Prof. J. Bostock. A vote of thanks was moved by Prof. H. J. Wilkinson, seconded by Dr. M. F. Hickey and carried by acclamation.

Abstract of Proceedings, 24th April, 1944.

The Ordinary Monthly Meeting of the Society was held in the Geology Department of the University on Monday, 24th April, at 8 p.m., with the President (Mr. F. A. Perkins) in the chair. About forty members and friends were present. The minutes of the previous meeting were read and confirmed. Miss B. Campbell was elected to Ordinary Membership, and Mr. E. G. Le Breton to Associate Membership. Miss H. Clark was proposed for Ordinary Membership.

Dr. D. A. Herbert exhibited a collection of subterranean fungi, including *Polyporus mylittae* (Blackfellow's Bread), *P. tumulosus* (a mound-forming fungus), and species of *Hymenogaster* and *Rhizopogon*. Specimens of *Panaeolus ovatus* from Eudlo were tabled; this species was responsible for five cases of mushroom poisoning at Eudlo in December, 1943.

Dr. J. Legg exhibited hairballs taken from cattle, the jaw of a bovine showing the gross lesions of actinomycosis, and a set of lower jaws from sheep of different ages, all of which was affected by chronic endemic fluorosis. He traced the history of the disease, and showed how the etiology of this wide-spread malady was elucidated. He suggested that Dr. M. White, who had given him these specimens, should outline the extent and distribution of fluorosis among animals in Queensland. Dr. White gave some interesting details of investigations he was conducting into fluorosis among animals drinking underground supplies of water containing fluorine. He also exhibited an unusual type of enterolith taken from a cow.

Dr. I. Lauder exhibited isotopic forms of water. The origin of the term isotope was explained, and then the factors which give rise to the existence of isotopes were considered. The separation of the hydrogen isotopes by electrolysis and the oxygen isotopes by thermal diffusion were reviewed very briefly. A demonstration of the difference in properties between normal water and heavy hydrogen water was then given.

Mr. E. F. Riek exhibited a representative collection of the crayfish of Queensland, and discussed their zonal distribution and phylogeny. In conclusion he made a few remarks on the distribution of the family Parastacidae, or crayfish of the southern hemisphere, supporting the hypothesis that these crayfish arose in a single centre before the disruption of the original Gondwanaland into the present continents.

Mr. D. G. Bieske exhibited two continuous liquid-liquid extraction units—one for extraction from a light liquid using a heavy liquid, and the other for extraction from a heavy liquid using a lighter solvent. Their methods of separation, together with advantages and disadvantages, were explained.

Mr. J. B. Wadley exhibited some photographs of scientific interest.

Abstract of Proceedings, 29th May, 1944.

The Ordinary Monthly Meeting of the Society was held in the Sir William Macgregor School of Physiology on Monday, 29th May, at 8 p.m., with Prof. J. Bostock (Vice-President) in the chair. About forty members and friends were present. The minutes of the previous meeting were read and confirmed. Miss H. Clarke was elected to Ordinary Membership, and Mr. D. G. Bieske and Mr. W. Roulston were proposed for Ordinary Membership.

The business of the meeting comprised lectures and demonstrations on "Physiological Aspects of Tropical Warfare" by the Physiology Department.

Dr. R. Courtice spoke on the effects of hot climates on man. He mentioned the more important bodily adjustments as being cutaneous vasodilatation, sweating, loss of appetite, and reduced desire for work. and discussed the more important disturbances in carrying out these adjustments. He said that acclimatisation is divided into a primary stage of rapid adjustment lasting 7-14 days, followed by a secondary period of slow further adjustment lasting up to two years. Heat stroke, heat exhaustion, and heat cramp were considered to be the main acute failures of adjustment.

Prof. D. H. K. Lee discussed the morale of tropical living. He stated the importance of incorporating definite objectives as a part of personal and community planning, of providing amenities to relieve monotony, of providing for the additional nutritional requirements called for under tropical conditions, and of designing houses suitable to tropical climates. In conclusion, he formulated a set of rules to be applied to life in the tropics.

Demonstrations included the results of experiments carried out on subjects under tropical conditions, instruments used in measuring climatic conditions, an apparatus for testing efficiency under various conditions, the effects of different clothing materials on evaporation of sweat, the electrometric titration of chlorides in sweat, and the extraction and testing of alkaloids from plants.

Abstract of Proceedings, 26th June, 1944.

The Ordinary Monthly Meeting of the Society was held in the Department of Geology of the University on Monday, 26th June, at 8 p.m., with the President (Mr. F. A. Perkins) in the chair. Forty-three members and friends were present. The minutes of the previous meeting were read and confirmed. Mr. D. G. Bieske and Mr. W. Roulston were elected to Ordinary Membership. A medal received from the Royal Society of Tasmania in celebration of its centenary was on exhibit.

In a lecture entitled "The Geology of Central Australia," Dr. H. I. Jensen emphasised that unfossiliferous formations cannot be correlated with one another if separated by wide unexamined areas. The geology of the Territory must be understood before it is possible to correlate archæozoic and palæozoic formations in Queensland with those in Western Australia. He paid tribute to Dr. Madigan's excellent work in the Macdonnell Ranges. He outlined the physiography, stratigraphy and petrography of the Central Australian Massif, dealing particularly with the Harts Range, Strangway Range and the country north of these ranges as far as Barrow Creek. He contended that subsequent to the era of gneissification of the Arunta Complex, the oldest of the formations in Central Australia, there were two periods of volcanic action, igneous intrusion and mineralisation, the earlier of which occurred in the close of the Pertaknurra or Mosquito Creek period, and the later, which has been generally regarded as of Nullagine age, in the early Cambrian. The mineralisation which occurs in many places in the Cambrian series was considered evidence of this. He claimed that the so-called Nullagine would probably be found with more detailed investigation to be largely Lower Cambrian. He described the economic minerals found in the Central Australian Massif and in a wide region north of it and outlined the reasons why the working of so many of these minerals was not an economic proposition under present conditions. The soils of the Territory are essentially of windblown origin, fertile if water could be brought to them. There is, however, no true artesian or subterranean water in the area dealt with. The only ground water obtainable is in faults or in broken strata hemmed in by dykes. It needs a geologist to guide water boring in such areas to obviate waste of money. In conclusion he described the present condition of Alice Springs and the region around it and pointed out that unless pastoral country was periodically rested for a number of years there was some danger of the cattle areas becoming desert since the cattle for half the year feed on the arboreal vegetation. They break down the trees and eat down all young trees, thus giving shifting sand a chance to take the place of timber. Organisation to enforce the resting of pastoral areas is badly needed.

Abstract of Proceedings, 31st July, 1944.

The Ordinary Monthly Meeting of the Society was held in the Department of Geology of the University on Monday, 31st July, at 8 p.m., with the President (Mr. F. A. Perkins) in the chair. Twenty-five members and friends were present. The minutes of the previous meeting were read and confirmed. Miss Leone Tod and Dr. E. J. Reye were nominated for Ordinary Membership, and Mr. A. M. Tuffley, Mr. T. D. Dimmick, and Mr. N. Hoyling for Associate Membership.

Prof. T. G. H. Jones gave an account of the life and work of John Dalton, in which attention was paid to the time in which he lived and the limitations imposed on scientific work in its early stages of development. It was stressed that Dalton had achieved scientific fame of the highest order in placing chemistry with his atomic theory on a quantitative basis. Dalton's law of partial pressures, his contribution to the law governing the thermal expansion of gases, the atomic theory and the Dalton system of chemical notation, the determination of atomic weights, the law of combining proportions were reviewed and the value of these contributions to scientific progress discussed. It was concluded that the Royal Society could in the centenary year of his death pay well deserved honour to his memory.

The following papers were presented:—

"Triassic Insects of Queensland. I. Eoses, a Probable Lepidopterous Insect from the Triassic Beds of Mount Crosby, Queensland," by N. B. Tindale, communicated by Mr. T. D. Dimmick.

"Some Permian Foraminifera from Eastern Australia," and "Permian Ostracoda from Eastern Australia," by Irene Crespin, communicated by Mr. O. A. Jones.

"On Streptachne R. Brown and Pheidochloa genus novum, two genera of grasses from Queensland," by S. T. Blake.

Dr. H. I. Jensen exhibited on behalf of Mr. F. Konig, miner, Innott Hot Springs, a fine collection of tin and tin-topaz specimens from Mr. F. Konig's mine on Mt. Gibson. He also showed specimens of Coorongite from South Australia and Kauri Gum from Mt. Spurgeon, North Queensland.

Abstract of Proceedings, 28th August, 1944.

The Ordinary Monthly Meeting of the Society was held in the Geology Department of the University on Monday, 28th August, at 8 p.m., with the President (Mr. F. A. Perkins) in the chair. About fifty members and friends were present. The minutes of the previous meeting were read and confirmed. Miss L. Tod and Dr. E. J. Reye were elected to Ordinary Membership, and Mr. A. M. Tuffley, Mr. T. D. Dimmick, and Mr. N. Hoyling to Associate Membership. Mr. C. C. Chapman was proposed for Ordinary Membership.

Films were shown of native life in the Mount Liebig region of Central Australia, accompanied by a commentary by Mr. T. G. H. Strehlow. The speaker first made some introductory remarks on the history and general background of the Mount Liebig expedition film. This expedition was organised by the Anthropological Board of the

Adelaide University in August, 1932. Funds came from the Australian National Research Council. Coloured slides—generously loaned by Mr. C. P. Mountford, of Adelaide—were shown of the McDonnell Range country traversed by the expedition on the way to Mount Liebig, 210 miles west of Alice Springs. The speaker then gave a brief outline of the barren territory inhabited by the Pintubi tribe—who were the subjects studied by the expedition. Mount Liebig was the assembly point to which the natives had been induced to come by the speaker, who made a 500-mile round trip through the Pintubi territory with the aid of a Pintubi guide. The country is very poor, with no creeks, and high sandhills. It is poor mulga country, the only waters being limestone soaks and little rockholes in half buried rocks in the desert. Living conditions are extremely hard in this area. Life is one long struggle for existence. Hence implements and weapons are among the most primitive of Central Australia, and ceremonies are less elaborate than those of the Aranda.

Four films were then shown. The first showed the natives gathering food—witchetty grubs, honeyants, and roots. The second showed the manufacture of weapons—spear throwers, spears and boomerangs. The third depicted the ceremonies of simple love magic, "pointing the bone," and sacred ceremonies. In the last totemic ancestors are shown as they are imagined to have looked during their original wanderings. Down patterns (of eagle down) are put on the head and body of the main actor—stuck on with blood supplied by one of the younger men. Chanting goes on during the decorating, chant verses relating deeds of the ancestor. There is ceremonial quivering by the main actor. Finally comes a very brief and highly conventionalized piece of action, and in conclusion a member of the chorus embraces the main actor or actors. The fourth film depicted further ceremonies, including a yam ceremony, a man ceremony, and a kangaroo ceremony. The evening ended with a few concluding remarks and a further set of coloured slides.

Abstract of Proceedings, 25th September, 1944.

The Ordinary Monthly Meeting of the Society was held in the Department of Geology of the University on Monday, 25th September, at 8 p.m., with the President (Mr. F. A. Perkins) in the chair. Fifty-four members and friends were present. The minutes of the previous meeting were read and confirmed. Mr. C. C. Chapman was elected to Ordinary Membership.

Professor H. C. Richards gave a lecture entitled "Heavy Beach Deposits of Eastern Australia—Rutile, Monazite, Zircon, etc." He dealt with the nature, origin, distribution, and economic uses of the heavy minerals associated with the beach sands of Eastern Australia. He indicated the similarity of these deposits in general character (I.) to those of Florida, Brazil and Travancore which in the past have been very important sources of supply of monazite and (II.) to the iron sands of Japan and New Zealand. It was pointed out that the distinctive character of the Australian Deposits between the Clarence River and Southport was their comparative richness in Zircon and Rutile, two industrial minerals in great demand to-day. The heavy

minerals of importance in general order of abundance are, Zircon (S.G. 4.5-4.7), Ilmenite (S.G. 4.5-5.0), Rutile (S.G. 4.18-4.25), Monazite (S.G. 4.9-5.3), Cassiterite (S.G. 6.8-7.1), gold and platinoid metals. The emphasis to-day is on the recovery of Zircon, Rutile, and Monazite because there is really no market for Ilmenite, and the other minerals are so patchy in their distribution and so small in amount. Much interest exists as to the origin of these minerals, and while crushed samples of the lacustrine sandstone of Mesozoic age near the more important beach deposits yield on panning the same heavy minerals in somewhat similar proportions, it is recognised that the sandstone must be a secondary source. General opinion favours as a primary source, igneous rocks, and the New England granite composite batholith is most favoured. To some minor extent the Cainozoic volcanic rocks on the coast may have contributed. Extension of the deposits inland from the present-day strand line has been determined in several borings on the slightly elevated coastal plain, so there seems little doubt as to existence of very extensive reserves of heavy minerals.

Dr. W. H. Bryan exhibited a graptolite from the Brisbane "Schists." The specimen was collected personally by Dr. Bryan on 20th September, 1944, when, accompanied by Mr. O. A. Jones, he led a party of senior students from the Department of Geology, University of Queensland, on a field excursion to Upper Brookfield. The site of the find is within the western limits of the Greater Brisbane area and is a road cutting in Portion 194, Parish Moggill, four-fifths of a mile south-east of Upper Brookfield school. Mr. O. A. Jones in speaking on the exhibit stated that it can be confidently placed in the genus *Diplograptus* and possibly in the sub-genus *Orthograptus*. He pointed out that as the fossil came from the horizon somewhere about the middle of the series, it suggested that a considerable portion of this thick series is Ordovician in age, that is, somewhat older than was previously thought. The only other graptolite recorded from Queensland was found at Tweed Heads by Mr. A. K. Denmead in the upper part of the underlying Bunya Series. Although this is at a considerably lower horizon than the specimen exhibited, it also belonged to the Diplograptidae.

Abstract of Proceedings, 30th October, 1944.

The Ordinary Monthly Meeting of the Society was held in the Department of Geology of the University on Monday, 30th October, at 8 p.m., with the President (Mr. F. A. Perkins) in the chair. Twenty-five members and friends were present. The minutes of the previous meeting were read and confirmed. Dr. Alan Earnshaw was nominated for Ordinary Membership.

Mr. C. T. White delivered the Tryon Memorial Lecture entitled "Henry Tryon and His Place in Queensland Science." Henry Tryon was born in England in 1856 and died at Brisbane in 1943. After a primary education at Sherwood and later as a medical student at the London University, he travelled to New Zealand. He came to Queensland in 1882 and was appointed Assistant Director of the Queensland Museum in 1883. In 1894 he was appointed Government Entomologist at the Department of Agriculture and in 1901 became also Government

Plant Pathologist. He was the first Secretary of the Royal Society of Queensland and took an active part in the scientific life of Brisbane. He contributed many papers on natural history largely to Government publications and to the Proceedings of this Society. In 1895 Tryon visited British New Guinea to collect sugar-cane varieties which were imported into Australia. He brought back 66 varieties, including the well-known Badila, which is considered to be the best variety of sugar-cane ever introduced into Queensland. He was a member of a travelling commission appointed in 1912 to visit the many countries where prickly-pears were indigenous or naturalised, to investigate means of control that might be applied in Australia. A complete list of his publications was given in the "Queensland Agricultural Journal" for August, 1929.

Miss E. N. Marks exhibited the larva of *Aedes* (*Finlaya*) *biocellatus* (Taylor). The female of this mosquito was described by Taylor in 1914 (Proc. Linn. Soc. N.S.W., XXXIX., 463) under the name *Culex biocellatus* from specimens taken by Drs. Ferguson and Cleland on Milson Is., Hawkesbury River, N.S.W. It is referred to as *Aedes* (*Finlaya*) *biocellatus* by Edwards (1924 Bull. Ent. Res. XIV., 381). No other references to it have been found. The larva is here recorded for the first time. Adult males, also hitherto unrecorded, have been bred out from collections of larvae and pupae. The type specimen was not available for examination in Sydney in May, 1944, but a male specimen bred out November, 1943, from larvae from Mt. Glorious was compared in detail with a female from the type locality, 1913, determined by F. W. Edwards. There could be no doubt that both belonged to the same species. Larvae are found in treeholes in rain forest. Earliest specimens in the collection of the University of Queensland are larvae from Mt. Glorious, September, 1942, collected by F. A. Perkins, and bred adults, October and November, 1942. Larvae were collected from the same treehole in October and November, 1943. In July, 1943, this hole was dry and leaf mould collected from it was placed in a dish and covered with tap water. Four weeks later 4th instar *biocellatus* larvae were observed. These were separated into a jar, but failed to pupate. Three weeks later another series of 4th instar larva was present, and from these adult *biocellatus* were bred out. Further samples of larvae were collected by Lieut. J. L. Wassell from treeholes at Wengen Creek and Mt. Mowbullan, Bunya Mts., September, 1944, and individual specimens have been bred out from these, so that correlated adults and larval and pupal skins are available. In the latest key to larvae of Genus Aedes (Lee, 1944, An Atlas of the mosquito larvae of the Australasian region) *A. biocellatus* would come out with *Aedes* (*Finlaya*) *alboannulatus,* but it shows no close affinity to this species.

Mr. S. T. Blake showed specimens of *Polypodium pustulatum, Arthropteris Beckleri,* and *Helicia diversifolia* illustrating different types of polymorphy in leaves.

Dr. D. A. Herbert exhibited *Cordyceps muscae,* a fungus attacking *Sarcophaga* sp., collected by Capt. R. F. Langdon at Port Moresby in July, 1944. He also exhibited *Cordyceps* sp. on the small brown ant, *Pheidole megacephala,* collected under the bark of *Eucalyptus tereticornis* at Southport, and specimens of the same species from Brisbane.

Dr. W. H. Bryan exhibited a scale model of a soil profile at the State Agricultural College, Lawes. The model, which is the work of Mr. P. J. Skerman, M.Sc.Agr., is on the scale of 1 inch to 1 foot and was

constructed by mounting a veneer of the soil itself on a rigid background. The result is a striking and realistic representation of a soil section that exhibits an unusual distribution of two differently coloured horizons. The section as displayed in the field measures 30 feet long and 6 feet deep. Dr. Bryan suggested that this technique might have many valuable applications in pedology.

Mr. O. A. Jones exhibited a specimen of carbonised fossil wood embedded in welded tuff from the cliffs at Kangaroo Point. The wood structure is unusually well preserved and apparent to the naked eye. For comparison he showed other specimens from the welded tuff and from the bedded tuff usually found at the base of the welded tuff. The fossil wood so common in the bedded tuff is always of the ordinary silicified type and is in striking contrast to the infrequent and always carbonised fossil wood from the welded tuff. The carbonisation of the latter indicates the high temperature of the welded tuff when ejected.

Abstract of Proceedings, 27th November, 1944.

The Ordinary Monthly Meeting of the Society was held in the Geology Department of the University on Monday, 27th November, at 8 p.m., with the President (Mr. F. A. Perkins) in the chair. Twenty members and friends were present. The minutes of the previous meeting were read and confirmed. Dr. Alan Earnshaw was elected to Ordinary Membership.

Mr. E. T. Holdaway gave an address on the "Determination of Longitude in Australia." during the course of which he said that by the middle of the 18th century determinations of latitude were being made with fair accuracy, but longitude values were very erroneous. The observation of the transit of Venus on 3rd June, 1769, by James Cook, assisted by the development of the chronometer, was a big step forward. A further improvement in the determination of longitude in Australia was attained by the observation of a transit of Venus in this country in 1882, using the electric telegraph line from Greenwich to Sydney for the exchange of time-signals. Then in 1902 greater accuracy in time was obtained by means of the Pacific cable when Greenwich values were available *via* Canada. Finally, wireless time-signals were used, giving the value at Sydney as 10 h. 4 m. 49.19 sec. The earliest value at Sydney was 10 h. 4 m. 50.31 sec.; the difference appears to support the idea of continental drift.

PUBLICATIONS RECEIVED.

The following Institutions and Societies are on our Exchange List, and their publications are hereby gratefully acknowledged. Owing to war conditions some exchanges have temporarily lapsed.

ARGENTINE—

Dereccion general de Estadistica, Buenos Aires.
Observatorio M. Lasagna.
Universidad de Buenos Aires.
Universidad National de La Plata.

AUSTRALIA—

General—

A.W.A.
Australasian Association for the Advancement of Science.
Australasian Institute of Mining Engineers.
Australian Chemical Institute.
Australian Institute of Mining and Metallurgy.
Australian Journal of Experimental Biology and Medical Science.
Australian Science Abstracts.
Australian Veterinary Society.
Council for Scientific and Industrial Research.
Standards Association of Australia.

Federal Government—

Commonwealth Bureau of Census and Statistics, Canberra.
Department of Health.
Forestry Bureau.

New South Wales—

Australian Museum, Sydney.
Botanic Gardens, Sydney.
Department of Agriculture, Sydney.
Department of Fisheries, Sydney.
Department of Mines, Sydney.
Geological Survey.
Linnean Society of New South Wales.
Naturalists' Society of New South Wales.
N.S.W. National Herbarium.
Public Library, Sydney.
Royal Society of New South Wales.
Technological Museum, Sydney.
University of Sydney.

Queensland—

Crohamhurst Observatory.
Department of Agriculture, Brisbane.
Department of Mines, Brisbane.
Government Statistician, Queensland.
North Queensland Naturalists' Club.
Queensland Museum, Brisbane.
Queensland Naturalists' Club, Brisbane.
Queensland, University of.
Royal Geographical Society of Australasia (Queensland), Brisbane.

South Australia—

Adelaide, University of.
Department of Mines, Adelaide.
Geological Survey, Adelaide.
Public Library, Museum and Art Gallery, Adelaide.
Royal Geographical Society of Australasia, Adelaide.
Royal Society of South Australia.
Royal Society of South Australia, Field Naturalists' Section.
Waite Agricultural Research Institute.

Tasmania—

Geological Survey.
Mines Department.
Queen Victoria Museum, Launceston.
Royal Society of Tasmania.
Tasmania, University of.

Victoria—

Department of Agriculture, Melbourne.
Department of Mines, Melbourne.
Field Naturalists' Club of Victoria.
Geological Survey.
McCoy Society, Melbourne.
National Museum, Melbourne.
Royal Society of Victoria.

Western Australia—

Geological Survey.
Mines Department, Perth.
Royal Society of Western Australia.

AUSTRIA—

Naturhistorisches Museum, Vienna.

BELGIUM—

Académie Royale de Belgique.
Société Royale de Botanique de Belgique.
Société Royale Zoologique de Belgique.

BRAZIL—
Instituto de Biologia Vegetal, Rio de Janeiro.
Instituto Oswaldo Cruz, Rio de Janeiro.
Government. Departmento Nacionale da Produccao Animal.
Government. Servico Geologico e Mineralogico.
Ministerio de Agricultura Industria y Commercio, Rio de Janeiro.
Museu Paulista, Sao Paulo.
Universidade de Sao Paulo.

CANADA—
Department of Agriculture, Ottawa.
Department of Mines, Ottawa.
Geological Survey, Ottawa.
Nova Scotian Institute of Science.
Royal Astronomical Society of Canada.
Royal Canadian Institute.
Royal Society of Canada.

CEYLON—
Ceylon Journal of Science.
Colombo Museum.

CHILE—
Sociedad de biologia de Conception.

CUBA—
Sociedad Geografica de Cuba, Habana.
Universidad de Habana.

CZECHOSLOVAKIA—
Acta botannica Bohemica.
Charles University, Prague.
Czechoslovakian Entomological Society.
Masarykova Universita, Brno.

DENMARK—
The University, Copenhagen.

ESTONIA—
Tartu University.

FINLAND—
Societas pro fauna et flora fennica.

FRANCE—
Marseille Faculté des Sciences.
Montpellier, University of.
Museum National d'Histoire naturelle, Paris.
Société botanique de France.
Société des Sciences naturelles de l'Ouest, Nantes.
Société entomologique de France.
Société française de microscopie.
Société géologique et mineralogique de Bretagne, Rennes.
Société scientifique de Bretagne, Rennes.
Station Zoologique de Cette.

FORMOSA—
Taihoku Imperial University.

GERMANY—
Akademie der Wissenschaften, Leipzig.
Badische Landsverein für Naturkunde.
Bayerische Akademie der Wissenschaften, Munich.
Botanische Garten u. Museum, Berlin.
Deutsche Entomologische Institut.
Deutsche Geologische Gesellschaft, Berlin.
Deutsche Kolonial- und Uebersee Museum, Bremen.
Gesellschaft für Erdkunde, Berlin.
K. Leopoldinisch-Carolinische deutsche Akademie der Naturforscher, Halle.
Museum für Naturkunde, Berlin.
Naturhistorisch-medizinischer Vereins, Heidelberg.
Naturhistorischer Verein der preus. Rheinland und Westfalens, Bonn.
Naturwissenschaftlicher Verein zu Bremen.
Reichsamt für Wetterdienst, Berlin.
Sächsische Akademie der Wissenschaften, Leipzig.
Senckenbergische Bibliothek, Frankfurt a. Main.
Zentralblatt für Bakteriologie, *etc.*
Zoologisches Museum, Berlin.
Zoologisches Museum, Hamburg.

GOLD COAST—
Geological Survey.

GREAT BRITAIN—
Botanical Society of Edinburgh.
Bristol Museum and Art Gallery.
British Museum (Natural History), London.
Cambridge Philosophical Society.
Conchological Society of Great Britain and Ireland, Manchester.
Imperial Agricultural Bureaux.
Imperial Bureau of Plant Genetics, Aberystwyth.
Imperial Institute of Entomology, London.
Leeds Philosophical and Literary Society.
Manchester Literary and Philosophical Society.
Rothamsted Experimental Station.
Royal Botanic Gardens, Kew.
Royal Empire Society, London.
Royal Society of Edinburgh.
Royal Society of London.
Wales, University College of.

HAWAII—
Bernice Pauahi Bishop Museum, Honolulu.

HOLLAND—
K. Akademie van Wetenschappen te Amsterdam.
Royal Netherlands Academy.
Technische Hoogeschool, Delft.
University of Amsterdam.

INDIA—
Geological Survey of India.
Imperial Agricultural Research Institute, New Delhi.

IRELAND—
Royal Dublin Society.
Royal Irish Academy, Dublin.

ITALY—
R. Accademia delle Scienze dell' Instituto di Bologna.
R. Instituto superiore agrario di Bologna.
Museo civico di storia naturale, Genoa.
R. Scuola superiore d'agricoltura in Portici.
Societa Toscana di Scienze Naturali, Pisa.

JAPAN—
Agricultural Chemical Society of Japan.
Japanese Journal of Zoology.
Kyoto Imperial University.
National Research Council of Japan, Tokyo.
Ohara Institut, Kurashiki.
Tokyo Bunrika Daigaku.
Tokyo Imperial University.

MEXICO—
Academia nacional de ciencias Antonio Alzate.
Instituto Geologico de Mexico.
Observatorio Meteorologico Central, Tacubaya.
Secretario de Agriculture y Fomento.

NETHERLANDS INDIES—
Jardin Botanique, Buitenzorg.
K. Naturkundige Vereeniging in Ned.-Indië.

NEW ZEALAND—
Auckland Institute and Museum.
Department of Scientific and Industrial Research, Wellington.
Dominion Laboratory, Wellington.
Dominion Museum, Wellington.
Geological Survey of New Zealand.
Royal Society of New Zealand.

PERU—
Sociedad Geologica del Peru.

PHILIPPINES—
Bureau of Science, Manila.

POLAND—
Geological Institute, Warsaw.
Panstwowe museum zoologiczne.
Polskie Towarzystwo Przyrodnikow im Kopernika, Lwow.
Sociétés Savantes Polonaises.
University of Lwow.

PORTUGAL—
Academia Polytechnicada, Oporto.
Instituto Botanico, Coimbra.
Sociedade Broterniana, Coimbra.

RUSSIA—
Academy of Sciences, Leningrad.
Bureau of Applied Entomology, Leningrad.
Laboratory of Palaeontology, Moscow University.
Lenin Academy of Agriculture Sciences, Leningrad.

SOUTH AFRICA—
Durban Museum, Natal.
Geological Society of South Africa, Johannesburg.
Natal Government Museum, Pietermaritzburg.
National Museum, Bloemfontein.
South African Museum, Capetown.
Transvaal Museum, Pretoria.

SPAIN—
Real Academia de Ciencias, Madrid.
Academia de Ciencias de Zaragoza.
Real Academia de Ciencias y Artes de Barcelona.
Museo de Historia Natural, Valencia.

SWEDEN—
Göteborgs K. Vetenskaps-och Vitterhets Samhället.
K. Fysiografiska Sällskapet, Lund.
Uppsala University.

SWITZERLAND—
Naturforschende Gesellschaft, Zurich.
Société de Physique et d'histoire naturelle, Genève.

TRINIDAD—
Imperial College of Tropical Agriculture.

URAGUAY—

Museo de historia natural, Montevideo.

UNITED STATES—

Academy of Natural Sciences, Philadelphia.
Academy of Science, St. Louis.
American Academy of Arts and Sciences, Boston.
American Geographical Society, New York.
American Museum of Natural History, New York.
American Philosophical Society, Philadelphia.
Arnold Arboretum, Jamaica Plains.
Boston Society of Natural Sciences.
Buffalo Society of Natural History.
California Academy of Sciences.
California, University of.
California, University of, Los Angeles.
Carnegie Institution, Washington.
Cornell University.
Federal Government—
Bureau of Standards.
Department of Agriculture.
Geological Survey.
Library of Congress.
Public Health Service.
Field Museum of Natural History, Chicago. (Now under new name.)
Florida State Geological Survey.
Harvard University.
Illinois Natural History Survey.
Illinois, University of.
Indiana Academy of Science.
Institute of Biological Research, Baltimore.
Iowa, University of.
John Crerar Library, Chicago.
Johns Hopkins University.
Kansas Academy of Science, Lawrence.
Kansas, University of.
Lloyd Library, Cincinnati.
Michigan Academy of Arts, Science, and Letters.
Michigan, University of.
Minnesota Geological Survey.
Minnesota, University of.
Missouri Botanic Garden, St. Louis.
Museum of Comparative Zoology, Harvard.
National Academy of Science, Washington.
National Research Council, Washington.
New York Academy of Sciences.
New York Zoological Society.
Ohio State University.
Portland Society of Natural History.
Puget Sound Biological Station, Seattle.
Rochester Academy of Science.
San Diego Society of Natural History.
Smithsonian Institution, Washington.
State College of Washington, Pullman.
United States National Museum, Washington.
Vanderbilt Marine Museum, Huntington.
Western Society of Engineers, Chicago.
Wisconsin Academy of Arts, Science, and Letters, Madison.
Wistar Institute of Anatomy and Biology, Philadelphia.
Yale University—
Bingham Oceanographic Laboratory.
Peabody Museum of Natural History.

List of Members.

Honorary Life Members.

*Bennett, F., B.Sc.	"Irby," 25th North Street, Mackay.
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Tilling, H. W., M.R.S.C. (Eng.), L.R.C.T. (Lond.)	Nairobi, Kenya, Africa.

Corresponding Members.

*Domin, Dr. K.	Czech University, Prague.
Gregory, Professor W. K.	Columbia University, New York.
*Skeats, Prof. E. W., D.Sc.	The University, Melbourne, Victoria.

Ordinary Members.

Archibald, Dr. L., M.Sc., M.B., B.S.	Health Department, Brisbane.
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Barker, F.	Railway Audit Office, Brisbane.
Barker, G. H	Adelaide Street, Brisbane.
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Bick, I. R., M.Sc.	The University, Brisbane.
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*Briton, N. W., B.Vet.Sc.	Agricultural College, Lawes.
Broe, J. J., M.Sc.	Central Technical College, Brisbane.
Brown, Graham, M.R.C.S., L.R.C.P., F.R.A.C.S.	371 Queen Street, Brisbane.

* Members who have contributed papers to the Society.

Brown, Jas., B.A., M.D., Ch.B. (Edin.), D.Ph. (Cambridge)	"Widmoorene," Margaret Street, Toowoomba
*Bryan, W. H., M.C., D.Sc.	The University, Brisbane.
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Caldwell, N. E. H., M.Agr.Sc. ..	Department of Agriculture and Stock, Box 519, Ayr.
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Carson-Cooling, Geo., M.Sc.	Boys' Grammar School, Brisbane.
Carter, S. B.Sc.	187 Waterworks Road Ashgrove, W. 3.
Cary, J. G.	9, Macaulay Street, Coorparoo.
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Chippendale, F., M.Agr.Sc.	Agricultural Experiment Station, Biloela.
Christian, C. S., M.Sc.	Division of Plant Industry, C.S.I.R., Canberra.
Cilento, Sir R. W., M.D., B.S. ..	Department of Health, Brisbane.
Clark, C., M.A...	Bureau of Industry, Brisbane.
Clarke, Miss H.	c/- W. Peterman, Box 194C, G.P.O., Brisbane.
Collins, Mrs. E., B.Sc.	4 Pearl Avenue, Chatswood, Sydney.
Coleman, F. B.	Department of Agriculture and Stock, Brisbane.
Connah, T. H., M.Sc.	Geological Survey Office, Brisbane.
Cottrell-Dormer, W., M.Agr.Sc. ..	Department of Agriculture and Stock, Brisbane.
Cribb, H. G., B.Sc.	Geological Survey Office, Brisbane.
Croll, Gifford, M.B.	Sherwood, Brisbane.
Cummings, R. P., M.A.	University of Queensland, Brisbane.
Daniels, C. L.	Mount Isa Mines Ltd., Mount Isa.
de Jersey, N. J., M.Sc.	Geology Department, University, Brisbane.
*Denmead, A. K., M.Sc.	Geological Survey, Brisbane.
Dixon, G. P., C.B.E., M.B., Ch.M. ..	Wickham Terrace, Brisbane.
*Dodd, Alan P., O.B.E.	Prickly-pear Laboratory, Sherwood, Brisbane.
Donaldson, R. J.	care of Gibbs, Bright, and Co., Queen Street, Brisbane.
Earnshaw, P. A., M.B., Ch.M., F.R.A.C.P.	Ballow Chambers, Wickham Terrace, Brisbane.
East, J. D., B.Sc.	District Geologist's Office, Rockhampton.
Edmiston, E. S., M.Sc.	The University, Brisbane.
Elliott, T. M. B.	Stanford X-ray Co. Pty., Ltd., Wickham Terrace, Brisbane.
Ellis, C., B.E.	Co-ordinator-General's Department, Brisbane.
Erskine, T. W., T.T.S.C.	Brisbane Boys' College, Toowong
Evans, C. K., M.Sc.	Fifer Street, Ipswich.
Everist, S. L., B.Sc..	Department of Agriculture, Blackall.
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